

# FCC PART 15.247

## TEST REPORT

For

### Huawei Technologies Co., Ltd

Administration Building, Headquarters of Huawei Technologies Co.,Ltd., Bantian,Longgang District,  
Shenzhen, 518129, P.R.C

**FCC ID: QISAP2030DN**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Wireless LAN Access Point
<b>Test Engineer:</b> Edison Hu	<i>Edison.hu</i>
<b>Report Number:</b> RKS161113002-00D	
<b>Report Date:</b> 2016-11-09	
<b>Reviewed By:</b> EMC Manager	<i>Jesse.Huang</i>
<b>Prepared By:</b> Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan, Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 <a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a>	

**Note:** This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The Huawei Technologies Co., Ltd 's product, model number: AP2030DN (FCC ID: QISAP2030DN) or the "EUT" in this report was a Wireless LAN Access Point, which was measured approximately: 25 mm (H)x 140 mm(W) x 86 mm(D), rated input voltage: DC voltage supplied From Adapter or PoE.

#### Adapter information:

Brand :HUAWEI

Model:HUAWEI/HW-120200U1W

AC INPUT: 100-240V, 0.8A,50-60Hz

DC OUTPUT: 12V, 2.0A

#### Manufacture information:

Huawei Technologies Co., Ltd / administration Building ,Headquarters of Huawei Technologies Co., Ltd .,  
Bantian,longgang District,Shenzhen,518129,P.R.C,China

*\*All measurement and test data in this report was gathered from production sample serial number: 20161018001.  
(Assigned by the BACL. The EUT supplied by the applicant was received on 2016-10-18)*

### Antenna information

Chain	Antenna Type	Max. Antenna Gain
0	PCB Antenna	3.8 dBi
1	PCB Antenna	3.3 dBi

### Objective

This report is prepared on behalf of Huawei Technologies Co., Ltd in accordance with Part 2-Subpart J, Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Related Submittal(s)/Grant(s)

FCC Part 15B JBP and FCC Part 15.407 NII submission with FCC ID: QISAP2030DN.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB558074 D01 DTS Meas Guidance v03r05.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with RF radiated emission is 5.91 dB for 30MHz-1GHz.and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

### **Test Facility**

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on No.248 Chenghu Road,Kunshan,JIANGSU province,China

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on November 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in testing mode, which was provided by manufacturer.

For 2.4G band, the device support SISO, 2 x 2 MIMO at 802.11 b, 802.11g and 802.11n system, 802.11n mode support both beamforming mode and Non-beamforming mode.

In the 2.4GHz band, 11 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	/	/

The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations. Preliminary tests were performed in difference data rate and all the possible configurations, the worst cases as below table and shown in the report.

Configurations	Test Mode	Data Rate	Channel	Antenna Chain
SISO	802.11b	1Mbps	1,6,11	0,1
	802.11g	6Mbps	1,6,11	0,1
	802.11 ht20	MCS0	1,6,11	0,1
	802.11 ht40	MCS0	3,6,9	0,1
2*2 MIMO Non- Beamforming	802.11b	1Mbps	1,6,11	0+1
	802.11g	6Mbps	1,6,11	0+1
	802.11 ht20	MCS0	1,6,11	0+1
	802.11 ht40	MCS0	3,6,9	0+1
2*2 MIMO Beamforming	802.11 ht20	MCS0	1,6,11	0+1
	802.11 ht40	MCS0	3,6,9	0+1

### Equipment Modifications

No modification was made to the EUT tested.

### EUT Exercise Software

The IPOR&QSPR was used for testing, and the commands were provided by manufacturer. The maximum power and duty cycle was set by commands as following table:

**1TX:**

Software and version			IPOR&QSPR		
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Power Level	
				Chain 0	Chain 1
802.11 b	Low	2412	1	18	18
	Middle	2437	1	18	18
	High	2462	1	18	18
802.11 g	Low	2412	6	18	18
	Middle	2437	6	18	18
	High	2462	6	18	18
802.11 n20	Low	2412	MCS0	18	18
	Middle	2437	MCS0	18	18
	High	2462	MCS0	18	18
802.11 n40	Low	2422	MCS0	17	17
	Middle	2437	MCS0	17	17
	High	2452	MCS0	17	17

**2TX Non-beamforming:**

Software and version			IPOR&QSPR	
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Power Level
				Chain 0&1
802.11 b	Low	2412	1	18
	Middle	2437	1	18
	High	2462	1	18
802.11 g	Low	2412	6	18
	Middle	2437	6	18
	High	2462	6	18
802.11 n20	Low	2412	MCS0	18
	Middle	2437	MCS0	18
	High	2462	MCS0	18
802.11 n40	Low	2422	MCS0	17
	Middle	2437	MCS0	17
	High	2452	MCS0	17

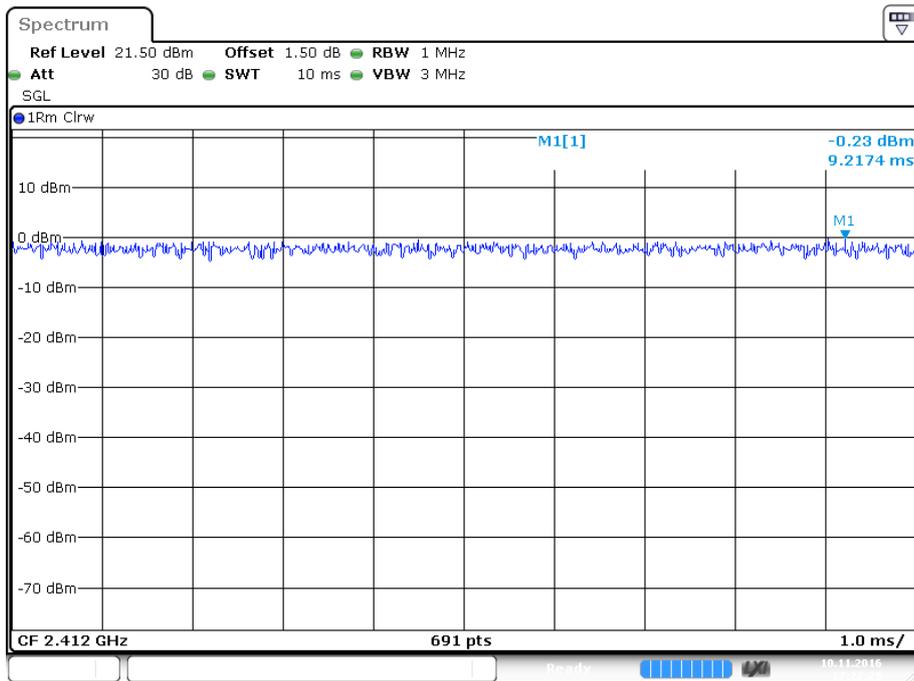
**2TX With beamforming:**

Software and version			IPOR&QSPR	
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Power Level
				Chain 0&1
802.11 n20	Low	2412	MCS0	18
	Middle	2437	MCS0	18
	High	2462	MCS0	18
802.11 n40	Low	2422	MCS0	17
	Middle	2437	MCS0	17
	High	2452	MCS0	17

The duty cycle as below:

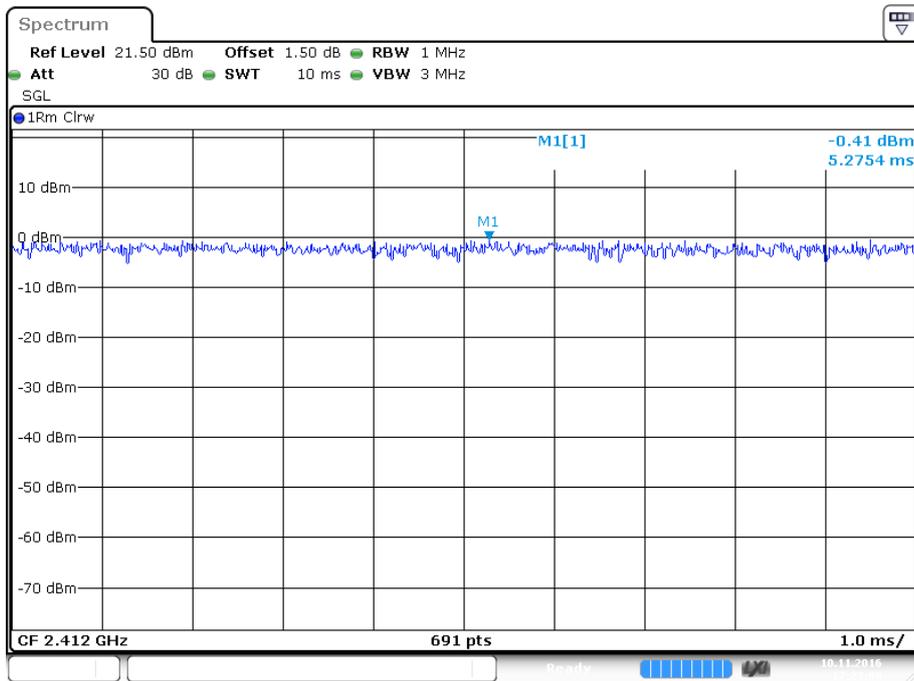
Mode	T <sub>on</sub> (ms)	T <sub>on+off</sub> (ms)	Duty Cycle (%)
802.11b	10	10	100
802.11g	10	10	100
802.11n ht20	10	10	100
802.11n ht40	10	10	100

### 802.11b



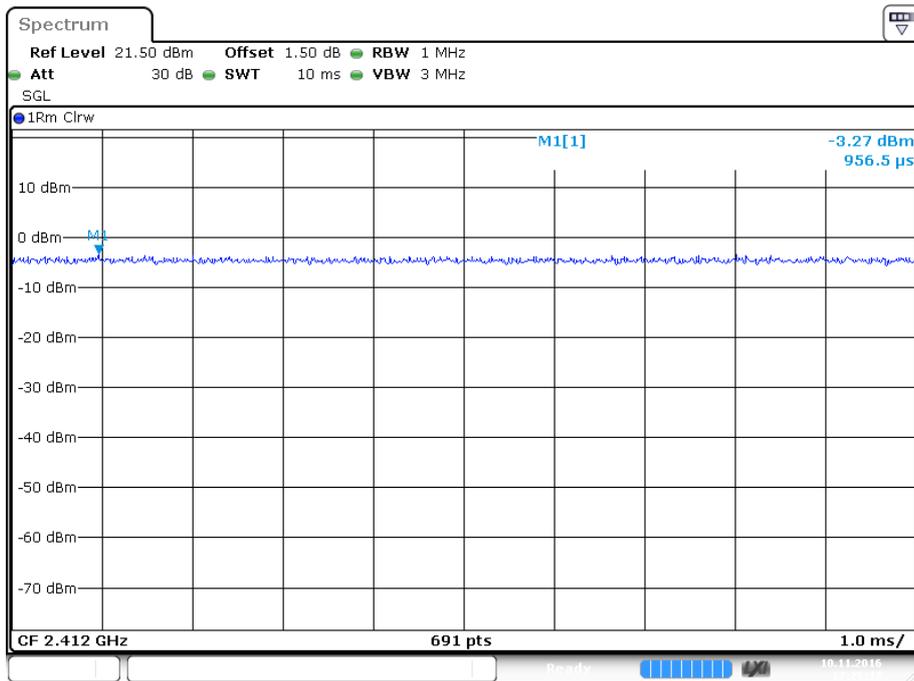
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### 802.11g



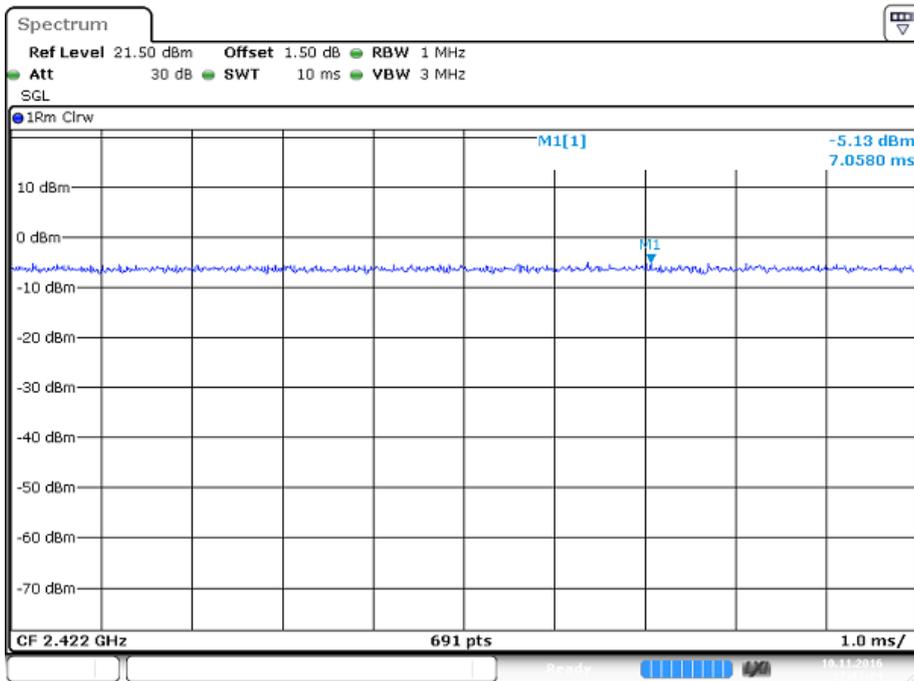
Date: 10 NOV 2016 17:23:09

### 802.11n ht20



Date: 10 NOV 2016 17:25:37

### 802.11n ht40



Date: 10 NOV 2016 17:31:24

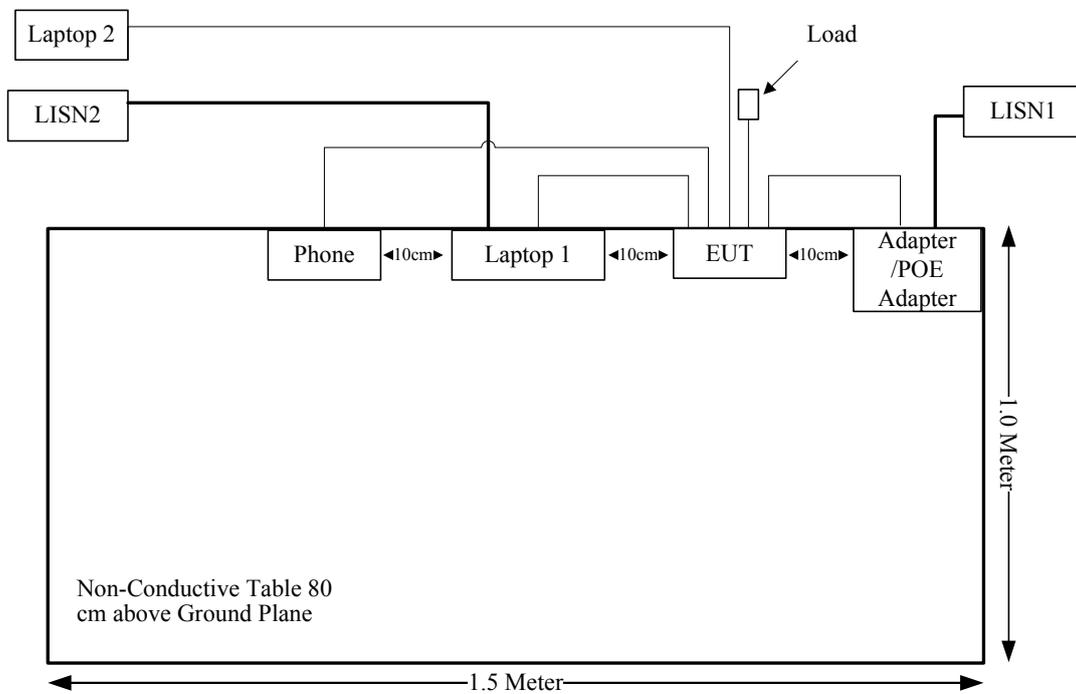
**Support Equipment List and Details**

Manufacturer	Description	Model	Serial Number
HP	Laptop 1	5600U	5CG6240ZH1
DELL	Laptop 2	D420	0002530
N/A	Load	N/A	N/A
AVAYA	Phone	6408D+	041611141185

**External I/O Cable**

Cable Description	Length (m)	From/Port	To
Un-shielding RJ 45 Cable	1.8	EUT	Laptop 1
Un-shielding RJ 45 Cable	1.0	EUT POE Port	POE Adapter
Un-shielding DC Cable	0.8	Adapter	EUT
Un-shielding RJ 11Cable	1.8	EUT	Phone
Un-shielding RJ 45 Cable*3	0.8	EUT	Load

**Block Diagram of Test Setup**



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§15.247 (i), §1.1307 (b) (1)& §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

**FCC§15.247 (i), §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**Applicable Standard**

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission’s guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
<b>Frequency Range (MHz)</b>	<b>Electric Field Strength (V/m)</b>	<b>Magnetic Field Strength (A/m)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>Averaging Time (minutes)</b>
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; \* = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

**Calculated Formulary:**

Predication of MPE limit at a given distance

S = PG/4 π R<sup>2</sup> = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

**Calculated Data:**

Frequency Band	Maximum Directional Gain		Maximum power including turn-up tolerance		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
2.4GHz	6.56	4.53	22	158.49	20.00	0.1429	1
5.8GHz	8.26	6.70	20	100.00	20.00	0.1333	1

Note: the antenna gain is Maximum Directional Gain, please refer to the conducted output power test section for detail.

The 2.4GHz and 5GHz band can transmit simultaneously:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$$=S_{2.4}/S_{limit-2.4} + S_5/S_{limit-5}$$

$$=0.14/1+0.13/1$$

$$=0.27$$

$$< 1.0$$

**Result: Compliance,** The device meets MPE requirement for Devices Used by the General Public (Uncontrolled Environment) at distance  $\geq 20$  cm.

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## **FCC §15.203 - ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has two PCB antenna arrangement for wifi, the antenna gain are 3.3dBi and 3.8 [dBi@2.4GHz](#) band, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

**FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS**

**Applicable Standard**

FCC§15.207

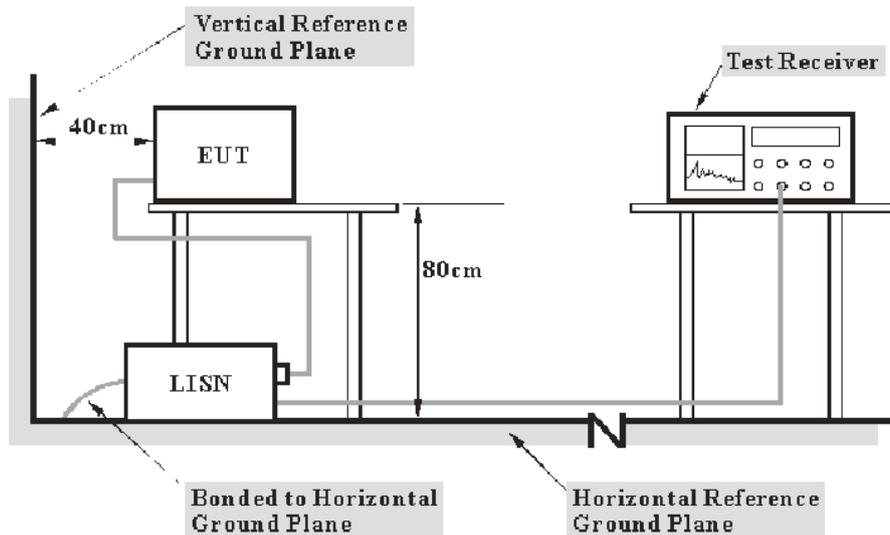
**Measurement Uncertainty**

Input quantities to be considered for conducted disturbance measurements may be receiver reading, attenuation of the connection between LISN and receiver, LISN voltage division factor, LISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expanded combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Kunshan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report.

Port	Expanded Measurement uncertainty
AC Mains	3.26 dB (k=2, 95% level of confidence)
CAT 3	3.70 dB (k=2, 95% level of confidence)
CAT 5	3.86 dB (k=2, 95% level of confidence)
CAT 6	4.64 dB (k=2, 95% level of confidence)

**EUT Setup**



- Note: 1. Support units were connected to second LISN.  
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The adapter was connected to a 120 VAC/60 Hz power source.

## EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

## Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	934115/007	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	892239/018	2016-07-04	2017-07-03
Rohde & Schwarz	Pulse limiter	ESH3-Z2	879940/0058	2016-06-19	2017-06-18
MICRO-COAX	Coaxial line	UFB-293B-1-0480-50X50	97F0173	2016-09-08	2017-09-08
Rohde & Schwarz	CE Test software	EMC 32	V 09.10.0	--	--

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(L_m)} \leq L_{lim} + U_{cispr}$$

In BACL,  $U_{(L_m)}$  is less than  $U_{cispr}$ , if  $L_m$  is less than  $L_{lim}$ , it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

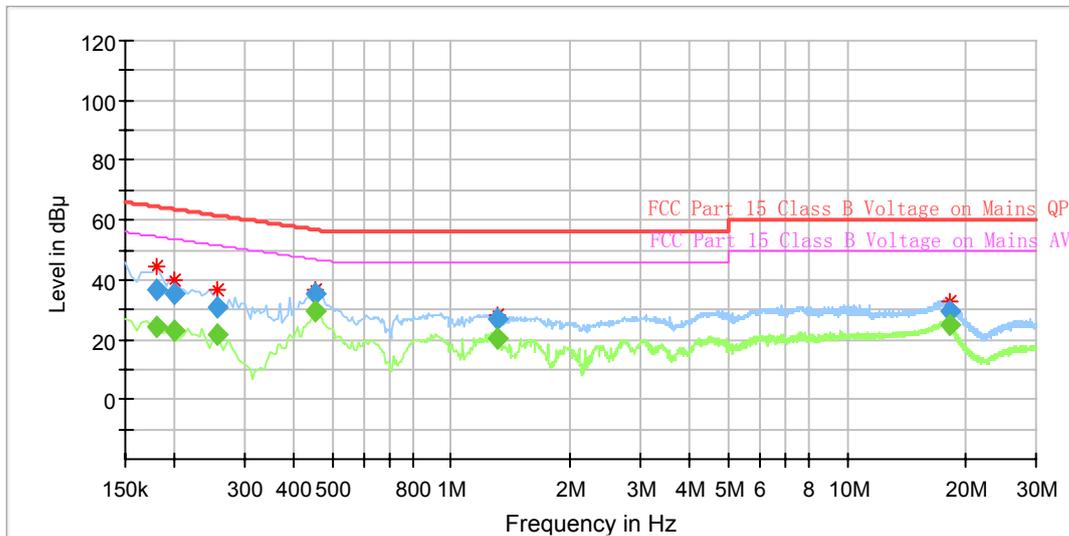
<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Edison Hu on 2016-10-20.*

*EUT operation mode: Transmitting*

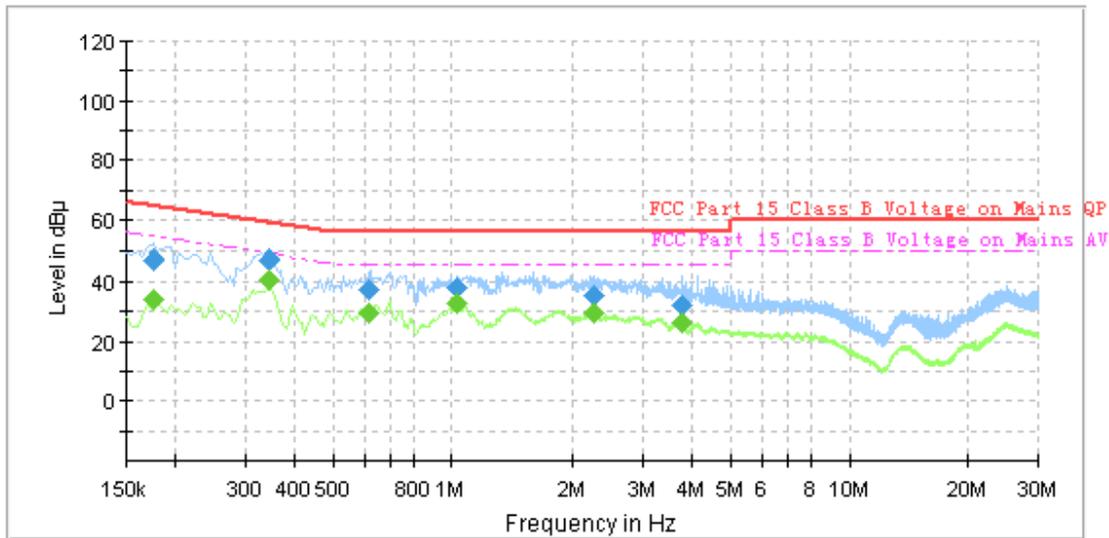
*Note: AC/DC adapter was the worst*

**AC 120V/60 Hz, Line**



Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.180000	---	24.14	9.000	L1	10.3	30.35	54.49	Compliance
0.180000	36.85	---	9.000	L1	10.3	27.64	64.49	Compliance
0.200000	---	23.24	9.000	L1	10.3	30.37	53.61	Compliance
0.200000	35.05	---	9.000	L1	10.3	28.56	63.61	Compliance
0.255000	---	21.77	9.000	L1	10.3	29.82	51.59	Compliance
0.255000	30.93	---	9.000	L1	10.3	30.66	61.59	Compliance
0.455000	---	29.55	9.000	L1	10.3	17.23	46.78	Compliance
0.455000	35.26	---	9.000	L1	10.3	21.52	56.78	Compliance
1.300000	---	20.51	9.000	L1	10.3	25.49	46.00	Compliance
1.300000	26.66	---	9.000	L1	10.3	29.34	56.00	Compliance
18.145000	---	25.02	9.000	L1	10.5	24.98	50.00	Compliance
18.145000	29.18	---	9.000	L1	10.5	30.82	60.00	Compliance

**AC 120V/60 Hz, Neutral**



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.165000	---	23.40	9.000	N	10.3	31.81	55.21	Compliance
0.165000	39.56	---	9.000	N	10.3	25.65	65.21	Compliance
0.270000	---	12.41	9.000	N	10.3	38.71	51.12	Compliance
0.270000	26.28	---	9.000	N	10.3	34.84	61.12	Compliance
0.460000	---	28.48	9.000	N	10.3	18.21	46.69	Compliance
0.460000	34.44	---	9.000	N	10.3	22.25	56.69	Compliance
0.905000	---	19.23	9.000	N	10.3	26.77	46.00	Compliance
0.905000	24.76	---	9.000	N	10.3	31.24	56.00	Compliance
2.995000	---	17.53	9.000	N	10.5	28.47	46.00	Compliance
2.995000	22.68	---	9.000	N	10.5	33.32	56.00	Compliance
18.085000	---	22.96	9.000	N	10.5	27.04	50.00	Compliance
18.085000	27.72	---	9.000	N	10.5	32.28	60.00	Compliance

- Note:**
- 1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
  - 2) Corrected Amplitude = Reading + Corr.
  - 3) Margin = Limit –Corrected Amplitude

## FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

### Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

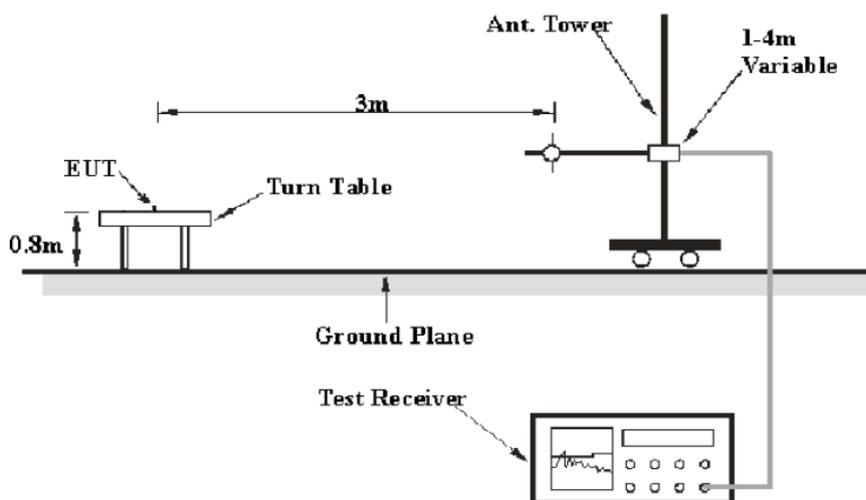
### Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

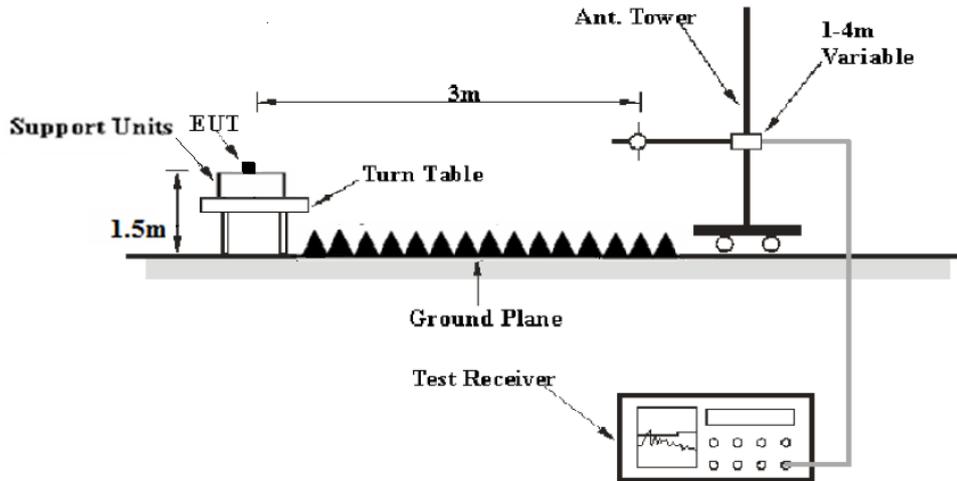
Based on CISPR 16-4-2:2011, the expanded combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Kunshan) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

### EUT Setup

#### Below 1 GHz:



**Above 1GHz:**



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The adapter was connected to a 120 VAC/60 Hz power source.

**EMI Test Receiver & Spectrum Analyzer Setup**

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:  
30-1000MHz:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP

1GHz- 25GHz:

Detector	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
Ave.	>98%	1MHz	10 Hz
	<98%	1MHz	1/T

**Test Procedure**

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	330	171377	2016-09-16	2017-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2015-11-12	2016-11-11
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2015-11-07	2016-11-06
ETS	Horn Antenna	3115	6229	2015-11-07	2016-11-06
EMCO	Horn Antenna	3116	9510-2384	2015-11-07	2016-11-06
Rohde & Schwarz	SIGNALANALYZER	FSV40	101116	2016-07-04	2017-07-03
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-11-12	2016-11-11
Mini	Pre-amplifier	ZVA-183-S+	857001418	2016-09-16	2017-09-16
DUCOMMUN	Pre-amplifier	ALN-22093530-01	990147	2016-09-16	2017-09-16
champrotek	Chamber	Chamber A	1#	2016-09-17	2017-09-17
R&S	Auto test Software	EMC32	V 09.10.0	-	-
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15
BACL	RF cable	KS-LAB-010	KS-LAB-010	2015-12-16	2016-12-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

### Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

### Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(L_m)} \leq L_{\text{lim}} + U_{\text{cispr}}$$

In BACL,  $U_{(L_m)}$  is less than  $U_{\text{cispr}}$ , if  $L_m$  is less than  $L_{\text{lim}}$ , it implies that the EUT complies with the limit.

**Test Data**

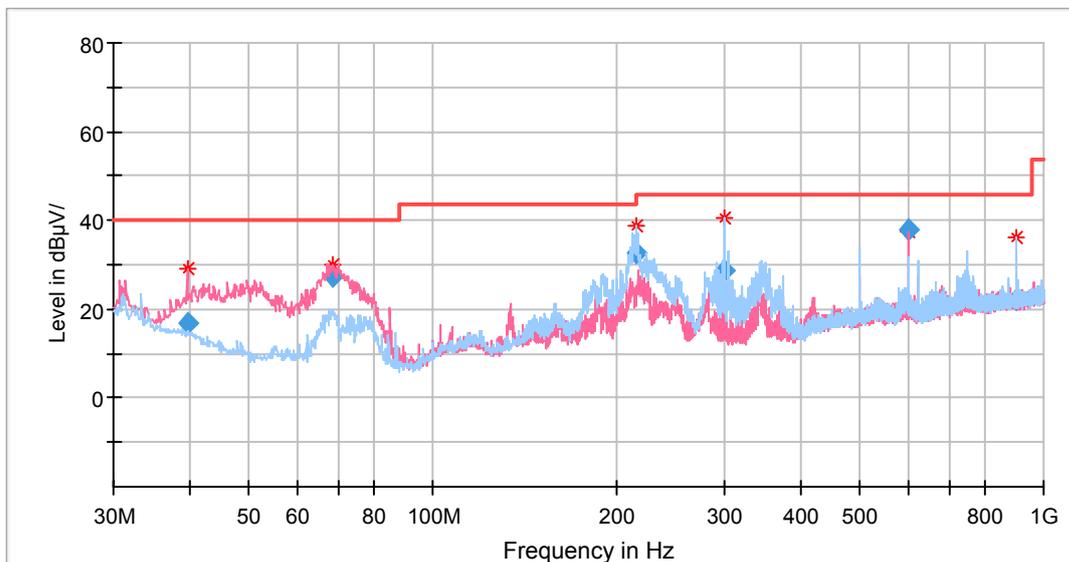
**Environmental Conditions**

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Edison Hu on 2016-10-19 to .2016-10-21.

**operation mode: Transmitting**

**30 MHz-1 GHz(2.4GHz band 802.11n ht40 2437MHz+5.8GHz band 802.11ac80 5775MHz was worst):**



Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.209	
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBµV/m)	Margin (dB)
33.459	30.62	QP	48	100	V	-6.9	23.72	40.0	16.28
81.9162	45.03	QP	148	100	V	-17	28.03	40.0	11.97
125.00505	52.33	QP	176	199	H	-14	38.33	43.5	5.17
250.00005	43.89	QP	15	199	H	-11.9	31.99	46.0	14.01
499.9998	44.73	QP	163	100	V	-5.6	39.13	46.0	6.87
749.9921	39.53	QP	31	100	V	-2.2	37.33	46.0	8.67

**1GHz-25GHz,  
Non-beamforming mode, 802.11b (MIMO mode was the worst):**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2412 MHz)									
2412.0	108.32	PK	210	185	V	-3.0	105.32	/	/
2412.0	103.99	Ave	210	185	V	-3.0	100.99	/	/
2412.0	103.13	PK	183	198	H	-3.0	100.13	/	/
2412.0	98.79	Ave	183	198	H	-3.0	95.79	/	/
2390.0	42.27	PK	140	250	V	-3.0	39.27	74	34.73
2390.0	30.29	Ave	140	250	V	-3.0	27.29	54	26.71
2400.0	50.48	PK	310	246	V	-3.0	47.48	74	26.52
2400.0	44.56	Ave	310	246	V	-3.0	41.56	54	12.44
4824.0	45.23	PK	239	122	H	7.2	52.43	74	21.57
4824.0	39.69	Ave	239	122	H	7.2	46.89	54	7.11
6620.0	30.62	PK	15	151	V	13.6	44.22	74	29.78
6620.0	21.87	Ave	15	151	V	13.6	35.47	54	18.53
7236.0	27.11	PK	290	101	H	16.0	43.11	74	30.89
7236.0	21.70	Ave	290	101	H	16.0	37.7	54	16.3
Middle Channel (2437 MHz)									
2437.0	108.28	PK	199	235	V	-3.0	105.28	/	/
2437.0	103.37	Ave	199	235	V	-3.0	100.37	/	/
2437.0	102.50	PK	328	106	H	-3.0	99.5	/	/
2437.0	97.56	Ave	328	106	H	-3.0	94.56	/	/
1477.0	42.13	PK	174	238	V	-7.0	35.13	74	38.87
1477.0	31.93	Ave	174	238	V	-7.0	24.93	54	29.07
1696.0	46.31	PK	221	162	H	-5.4	40.91	74	33.09
1696.0	37.34	Ave	221	162	H	-5.4	31.94	54	22.06
4874.0	32.97	PK	109	193	V	7.3	40.27	74	33.73
4874.0	27.13	Ave	109	193	V	7.3	34.43	54	19.57
6677.0	29.57	PK	329	157	H	13.8	43.37	74	30.63
6677.0	21.17	Ave	329	157	H	13.8	34.97	54	19.03
7311.0	26.58	PK	263	149	H	16.3	42.88	74	31.12
7311.0	20.87	Ave	263	149	H	16.3	37.17	54	16.83
High Channel (2462 MHz)									
2462.0	107.46	PK	330	196	V	-3.0	104.46	/	/
2462.0	103.23	Ave	330	196	V	-3.0	100.23	/	/
2462.0	102.25	PK	97	200	H	-3.0	99.25	/	/
2462.0	97.72	Ave	97	200	H	-3.0	94.72	/	/
2483.5	43.05	PK	148	173	V	-3.0	40.05	74	33.95
2483.5	32.47	Ave	148	173	V	-3.0	29.47	54	24.53
2563.0	46.64	PK	184	103	V	4.2	50.84	74	23.16
2563.0	34.57	Ave	184	103	V	4.2	38.77	54	15.23
4924.0	33.84	PK	284	120	H	7.4	41.24	74	32.76
4924.0	29.20	Ave	284	120	H	7.4	36.6	54	17.4
6681.0	31.86	PK	128	190	H	13.8	45.66	74	28.34
6681.0	21.07	Ave	128	190	H	13.8	34.87	54	19.13
7386.0	28.38	PK	212	156	H	16.7	45.08	74	28.92
7386.0	23.12	Ave	212	156	H	16.7	39.82	54	14.18

**Non-beamforming mode,802.11g, (MIMO was the worst):**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2412 MHz)									
2412.0	103.37	PK	91	121	V	-3.0	100.37	/	/
2412.0	99.19	Ave	91	121	V	-3.0	96.19	/	/
2412.0	98.44	PK	89	124	H	-3.0	95.44	/	/
2412.0	93.62	Ave	89	124	H	-3.0	90.62	/	/
2390.0	45.67	PK	110	201	V	-3.0	42.67	74	31.33
2390.0	32.22	Ave	110	201	V	-3.0	29.22	54	24.78
2400.0	44.37	PK	313	148	V	-3.0	41.37	74	32.63
2400.0	37.50	Ave	313	148	V	-3.0	34.5	54	19.5
4824.0	32.06	PK	108	222	H	7.2	39.26	74	34.74
4824.0	27.04	Ave	108	222	H	7.2	34.24	54	19.76
6620.0	30.92	PK	254	204	V	13.6	44.52	74	29.48
6620.0	22.31	Ave	254	204	V	13.6	35.91	54	18.09
7236.0	27.67	PK	52	230	H	16.0	43.67	74	30.33
7236.0	22.51	Ave	52	230	H	16.0	38.51	54	15.49
Middle Channel (2437 MHz)									
2437.0	103.31	PK	352	201	V	-3.0	100.31	/	/
2437.0	98.67	Ave	352	201	V	-3.0	95.67	/	/
2437.0	99.03	PK	255	105	H	-3.0	96.03	/	/
2437.0	94.37	Ave	255	105	H	-3.0	91.37	/	/
1477.0	44.53	PK	88	167	V	-7.0	37.53	74	36.47
1477.0	32.37	Ave	88	167	V	-7.0	25.37	54	28.63
1696.0	46.56	PK	266	249	H	-5.4	41.16	74	32.84
1696.0	35.74	Ave	266	249	H	-5.4	30.34	54	23.66
4874.0	32.75	PK	256	229	V	7.3	40.05	74	33.95
4874.0	28.56	Ave	256	229	V	7.3	35.86	54	18.14
6677.0	30.28	PK	103	176	H	13.8	44.08	74	29.92
6677.0	22.25	Ave	103	176	H	13.8	36.05	54	17.95
7311.0	27.37	PK	122	133	H	16.3	43.67	74	30.33
7311.0	22.95	Ave	122	133	H	16.3	39.25	54	14.75
High Channel (2462 MHz)									
2462.0	104.35	PK	334	115	V	-3.0	101.35	/	/
2462.0	99.93	Ave	334	115	V	-3.0	96.93	/	/
2462.0	101.11	PK	349	241	H	-3.0	98.11	/	/
2462.0	96.33	Ave	349	241	H	-3.0	93.33	/	/
2483.5	42.02	PK	355	214	V	-3.0	39.02	74	34.98
2483.5	32.59	Ave	355	214	V	-3.0	29.59	54	24.41
2563.0	42.76	PK	14	143	V	4.2	46.96	74	27.04
2563.0	37.46	Ave	14	143	V	4.2	41.66	54	12.34
4924.0	33.15	PK	112	140	H	14.0	47.15	74	26.85
4924.0	28.80	Ave	112	140	H	14.0	42.8	54	11.2
6681.0	30.63	PK	86	192	H	13.8	44.43	74	29.57
6681.0	21.22	Ave	86	192	H	13.8	35.02	54	18.98
7386.0	26.64	PK	249	192	H	16.7	43.34	74	30.66
7386.0	21.91	Ave	249	192	H	16.7	38.61	54	15.39

**Non-beamforming mode,802.11n ht40, (MIMO mode was the worst)**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2422 MHz)									
2422.0	104.07	PK	303	114	V	-3.0	101.07	/	/
2422.0	97.86	Ave	303	114	V	-3.0	94.86	/	/
2422.0	99.78	PK	24	170	H	-3.0	96.78	/	/
2422.0	93.64	Ave	24	170	H	-3.0	90.64	/	/
2390.0	44.50	PK	237	235	V	-3.0	41.5	74	32.5
2390.0	32.70	Ave	237	235	V	-3.0	29.7	54	24.3
2400.0	46.01	PK	308	249	V	-3.0	43.01	74	30.99
2400.0	37.24	Ave	308	249	V	-3.0	34.24	54	19.76
4844.0	34.37	PK	97	221	H	7.2	41.57	74	32.43
4844.0	27.13	Ave	97	221	H	7.2	34.33	54	19.67
6620.0	30.76	PK	84	243	V	13.6	44.36	74	29.64
6620.0	21.62	Ave	84	243	V	13.6	35.22	54	18.78
7266.0	27.22	PK	193	132	H	16.0	43.22	74	30.78
7266.0	19.92	Ave	193	132	H	16.0	35.92	54	18.08
Middle Channel (2437 MHz)									
2437.0	103.51	PK	350	176	V	-3.0	100.51	/	/
2437.0	97.50	Ave	350	176	V	-3.0	94.5	/	/
2437.0	100.13	PK	112	168	H	-3.0	97.13	/	/
2437.0	93.51	Ave	112	168	H	-3.0	90.51	/	/
1477.0	44.46	PK	305	204	V	-7.0	37.46	74	36.54
1477.0	31.79	Ave	305	204	V	-7.0	24.79	54	29.21
1696.0	42.62	PK	307	159	H	-5.4	37.22	74	36.78
1696.0	37.42	Ave	307	159	H	-5.4	32.02	54	21.98
4874.0	34.77	PK	83	172	V	7.3	42.07	74	31.93
4874.0	27.20	Ave	83	172	V	7.3	34.5	54	19.5
6677.0	29.08	PK	191	159	H	13.8	42.88	74	31.12
6677.0	21.65	Ave	191	159	H	13.8	35.45	54	18.55
7311.0	27.26	PK	340	154	H	16.3	43.56	74	30.44
7311.0	20.23	Ave	340	154	H	16.3	36.53	54	17.47
High Channel (2452 MHz)									
2452.0	98.32	PK	131	163	V	3.0	101.32	/	/
2452.0	91.57	Ave	131	163	V	3.0	94.57	/	/
2452.0	93.98	PK	57	123	H	3.0	96.98	/	/
2452.0	87.77	Ave	57	123	H	3.0	90.77	/	/
2483.5	42.89	PK	322	145	V	3.2	46.09	74	27.91
2483.5	31.43	Ave	322	145	V	3.2	34.63	54	19.37
2563.0	43.09	PK	107	227	V	4.2	47.29	74	26.71
2563.0	35.95	Ave	107	227	V	4.2	40.15	54	13.85
4904.0	33.33	PK	211	135	H	14.0	47.33	74	26.67
4904.0	26.26	Ave	211	135	H	14.0	40.26	54	13.74
6681.0	29.75	PK	36	113	H	13.8	43.55	74	30.45
6681.0	21.33	Ave	36	113	H	13.8	35.13	54	18.87
7356.0	27.85	PK	76	113	H	16.7	44.55	74	29.45
7356.0	20.11	Ave	76	113	H	16.7	36.81	54	17.19

**Non-beamforming mode,802.11n ht20, (MIMO mode was the worst)**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2412 MHz)									
2412.0	108.35	PK	350	212	V	-3.0	105.35	/	/
2412.0	103.47	Ave	350	212	V	-3.0	100.47	/	/
2412.0	103.67	PK	177	165	H	-3.0	100.67	/	/
2412.0	99.27	Ave	177	165	H	-3.0	96.27	/	/
2390.0	45.58	PK	172	122	V	-3.0	42.58	74	31.42
2390.0	31.11	Ave	172	122	V	-3.0	28.11	54	25.89
2400.0	44.97	PK	175	245	V	-3.0	41.97	74	32.03
2400.0	37.31	Ave	175	245	V	-3.0	34.31	54	19.69
4824.0	34.45	PK	137	245	H	7.2	41.65	74	32.35
4824.0	28.87	Ave	137	245	H	7.2	36.07	54	17.93
6620.0	31.92	PK	163	131	V	13.6	45.52	74	28.48
6620.0	23.22	Ave	163	131	V	13.6	36.82	54	17.18
7236.0	27.50	PK	172	147	H	16.0	43.5	74	30.5
7236.0	21.54	Ave	172	147	H	16.0	37.54	54	16.46
Middle Channel (2437 MHz)									
2437.0	107.97	PK	99	114	V	-3.0	104.97	/	/
2437.0	103.22	Ave	99	114	V	-3.0	100.22	/	/
2437.0	103.23	PK	227	139	H	-3.0	100.23	/	/
2437.0	98.28	Ave	227	139	H	-3.0	95.28	/	/
1477.0	43.22	PK	34	165	V	-7.0	36.22	74	37.78
1477.0	31.03	Ave	34	165	V	-7.0	24.03	54	29.97
1696.0	45.98	PK	352	236	H	-5.4	40.58	74	33.42
1696.0	34.68	Ave	352	236	H	-5.4	29.28	54	24.72
4874.0	34.08	PK	259	102	V	7.3	41.38	74	32.62
4874.0	28.55	Ave	259	102	V	7.3	35.85	54	18.15
6677.0	29.85	PK	275	154	H	13.8	43.65	74	30.35
6677.0	22.12	Ave	275	154	H	13.8	35.92	54	18.08
7311.0	28.77	PK	149	248	H	16.3	45.07	74	28.93
7311.0	23.65	Ave	149	248	H	16.3	39.95	54	14.05
High Channel (2462 MHz)									
2462.0	107.29	PK	82	208	V	-3.0	104.29	/	/
2462.0	103.01	Ave	82	208	V	-3.0	100.01	/	/
2462.0	104.12	PK	284	185	H	-3.0	101.12	/	/
2462.0	99.71	Ave	284	185	H	-3.0	96.71	/	/
2483.5	42.06	PK	84	174	V	-3.0	39.06	74	34.94
2483.5	33.83	Ave	84	174	V	-3.0	30.83	54	23.17
2563.0	43.25	PK	341	203	V	4.2	47.45	74	26.55
2563.0	35.56	Ave	341	203	V	4.2	39.76	54	14.24
4924.0	34.38	PK	77	170	H	14.0	48.38	74	25.62
4924.0	29.01	Ave	77	170	H	14.0	43.01	54	10.99
6681.0	31.67	PK	284	116	H	13.8	45.47	74	28.53
6681.0	21.72	Ave	284	116	H	13.8	35.52	54	18.48
7386.0	28.47	PK	216	135	H	16.7	45.17	74	28.83
7386.0	23.29	Ave	216	135	H	16.7	39.99	54	14.01

**Beamforming Mode, 802.11n-HT40:**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2422 MHz)									
2422.0	104.48	PK	303	114	V	-3.0	101.48	/	/
2422.0	98.35	Ave	303	114	V	-3.0	95.35	/	/
2422.0	100.35	PK	24	170	H	-3.0	97.35	/	/
2422.0	93.36	Ave	24	170	H	-3.0	90.36	/	/
2390.0	45.49	PK	237	235	V	-3.0	42.49	74	31.51
2390.0	30.57	Ave	237	235	V	-3.0	27.57	54	26.43
2400.0	46.07	PK	308	249	V	-3.0	43.07	74	30.93
2400.0	36.36	Ave	308	249	V	-3.0	33.36	54	20.64
4844.0	32.83	PK	97	221	H	7.2	40.03	74	33.97
4844.0	25.18	Ave	97	221	H	7.2	32.38	54	21.62
6620.0	30.03	PK	84	243	V	13.6	43.63	74	30.37
6620.0	23.14	Ave	84	243	V	13.6	36.74	54	17.26
7266.0	26.85	PK	193	132	H	16.0	42.85	74	31.15
7266.0	20.12	Ave	193	132	H	16.0	36.12	54	17.88
Middle Channel (2437 MHz)									
2437.0	104.18	PK	350	176	V	-3.0	101.18	/	/
2437.0	97.59	Ave	350	176	V	-3.0	94.59	/	/
2437.0	99.02	PK	112	168	H	-3.0	96.02	/	/
2437.0	92.97	Ave	112	168	H	-3.0	89.97	/	/
1477.0	45.97	PK	305	204	V	-7.0	38.97	74	35.03
1477.0	31.00	Ave	305	204	V	-7.0	24	54	30
1696.0	46.21	PK	307	159	H	-5.4	40.81	74	33.19
1696.0	36.10	Ave	307	159	H	-5.4	30.7	54	23.3
4874.0	33.57	PK	83	172	V	7.3	40.87	74	33.13
4874.0	26.63	Ave	83	172	V	7.3	33.93	54	20.07
6677.0	30.60	PK	191	159	H	13.8	44.4	74	29.6
6677.0	23.18	Ave	191	159	H	13.8	36.98	54	17.02
7311.0	28.97	PK	340	154	H	16.3	45.27	74	28.73
7311.0	21.05	Ave	340	154	H	16.3	37.35	54	16.65
High Channel (2452 MHz)									
2452.0	97.30	PK	131	163	V	3.0	100.3	/	/
2452.0	91.21	Ave	131	163	V	3.0	94.21	/	/
2452.0	91.68	PK	57	123	H	3.0	94.68	/	/
2452.0	84.99	Ave	57	123	H	3.0	87.99	/	/
2483.5	45.69	PK	322	145	V	3.2	48.89	74	25.11
2483.5	32.03	Ave	322	145	V	3.2	35.23	54	18.77
2563.0	45.42	PK	107	227	V	4.2	49.62	74	24.38
2563.0	36.84	Ave	107	227	V	4.2	41.04	54	12.96
4904.0	32.25	PK	211	135	H	14.0	46.25	74	27.75
4904.0	25.41	Ave	211	135	H	14.0	39.41	54	14.59
6681.0	29.24	PK	36	113	H	13.8	43.04	74	30.96
6681.0	21.70	Ave	36	113	H	13.8	35.5	54	18.5
7356.0	28.11	PK	76	113	H	16.7	44.81	74	29.19
7356.0	21.90	Ave	76	113	H	16.7	38.6	54	15.4

**Beamforming Mode, 802.11n-HT20**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
Low Channel (2412 MHz)									
2412.0	106.91	PK	350	212	V	-3.0	103.91	/	/
2412.0	102.72	Ave	350	212	V	-3.0	99.72	/	/
2412.0	101.93	PK	177	165	H	-3.0	98.93	/	/
2412.0	97.28	Ave	177	165	H	-3.0	94.28	/	/
2390.0	43.33	PK	172	122	V	-3.0	40.33	74	33.67
2390.0	31.12	Ave	172	122	V	-3.0	28.12	54	25.88
2400.0	45.95	PK	175	245	V	-3.0	42.95	74	31.05
2400.0	34.65	Ave	175	245	V	-3.0	31.65	54	22.35
4824.0	33.73	PK	137	245	H	7.2	40.93	74	33.07
4824.0	29.59	Ave	137	245	H	7.2	36.79	54	17.21
6620.0	29.96	PK	163	131	V	13.6	43.56	74	30.44
6620.0	23.02	Ave	163	131	V	13.6	36.62	54	17.38
7236.0	28.60	PK	172	147	H	16.0	44.6	74	29.4
7236.0	23.84	Ave	172	147	H	16.0	39.84	54	14.16
Middle Channel (2437 MHz)									
2437.0	106.40	PK	99	114	V	-3.0	103.4	/	/
2437.0	101.99	Ave	99	114	V	-3.0	98.99	/	/
2437.0	101.40	PK	227	139	H	-3.0	98.4	/	/
2437.0	97.35	Ave	227	139	H	-3.0	94.35	/	/
1477.0	44.34	PK	34	165	V	-7.0	37.34	74	36.66
1477.0	30.72	Ave	34	165	V	-7.0	23.72	54	30.28
1696.0	43.69	PK	352	236	H	-5.4	38.29	74	35.71
1696.0	34.96	Ave	352	236	H	-5.4	29.56	54	24.44
4874.0	34.36	PK	259	102	V	7.3	41.66	74	32.34
4874.0	29.96	Ave	259	102	V	7.3	37.26	54	16.74
6677.0	31.45	PK	275	154	H	13.8	45.25	74	28.75
6677.0	22.81	Ave	275	154	H	13.8	36.61	54	17.39
7311.0	26.86	PK	149	248	H	16.3	43.16	74	30.84
7311.0	22.10	Ave	149	248	H	16.3	38.4	54	15.6
High Channel (2462 MHz)									
2462.0	106.90	PK	82	208	V	-3.0	103.9	/	/
2462.0	102.18	Ave	82	208	V	-3.0	99.18	/	/
2462.0	102.70	PK	284	185	H	-3.0	99.7	/	/
2462.0	98.08	Ave	284	185	H	-3.0	95.08	/	/
2483.5	45.09	PK	84	174	V	-3.0	42.09	74	31.91
2483.5	30.66	Ave	84	174	V	-3.0	27.66	54	26.34
2563.0	43.27	PK	341	203	V	4.2	47.47	74	26.53
2563.0	34.24	Ave	341	203	V	4.2	38.44	54	15.56
4924.0	32.19	PK	77	170	H	14.0	46.19	74	27.81
4924.0	27.48	Ave	77	170	H	14.0	41.48	54	12.52
6681.0	30.86	PK	284	116	H	13.8	44.66	74	29.34
6681.0	23.87	Ave	284	116	H	13.8	37.67	54	16.33
7386.0	27.52	PK	216	135	H	16.7	44.22	74	29.78
7386.0	22.85	Ave	216	135	H	16.7	39.55	54	14.45

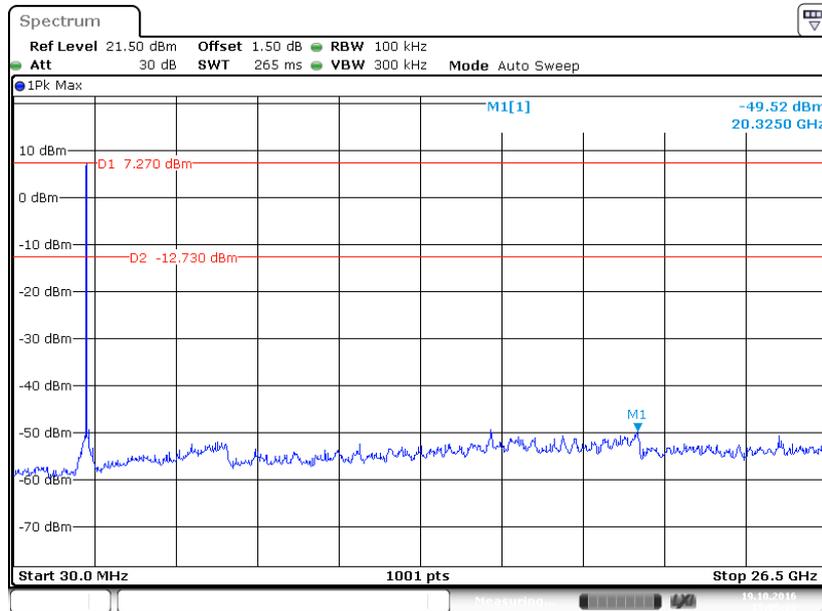
**Co-location:**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)				
2.4GHz band 802.11n ht40 2437MHz+5.8GHz band 802.11ac80 5775MHz Beamforming was worst									
4874.0	33.57	PK	83	172	V	7.3	40.87	74	33.13
4874.0	26.63	Ave	83	172	V	7.3	33.93	54	20.07
6677.0	29.85	PK	275	154	H	13.8	43.65	74	30.35
6677.0	22.12	Ave	275	154	H	13.8	35.92	54	18.08
7311.0	28.77	PK	149	248	H	16.3	45.07	74	28.93
7311.0	23.65	Ave	149	248	H	16.3	39.95	54	14.05
11570.0	39.14	PK	160	150	H	21.1	60.24	74	13.76
11570.0	27.29	AV	160	150	H	21.1	48.39	54	5.61
17355.0	28.44	PK	0	100	V	30.8	59.24	74	14.76
17355.0	17.30	AV	0	100	V	30.8	48.10	54	5.9
6662.0	32.89	PK	120	200	H	14.1	46.99	74	27.01
6662.0	25.87	AV	120	200	H	14.1	39.97	54	14.03
7551.0	33.13	PK	123	300	V	17.2	50.33	74	23.67
7551.0	26.32	AV	123	300	V	17.2	43.52	54	10.48

**Conducted Spurious Emissions at Antenna Port**

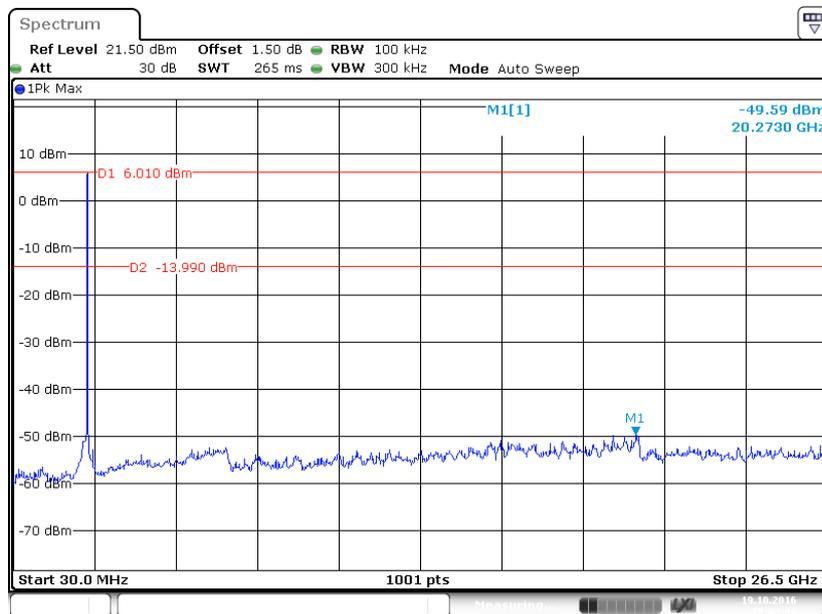
(SISO mode was test since maximum output power per chain, all emissions out of the operation band under the fundamental level 30dBc, please refer to the bellowing plots.)

**Chain 0 802.11b Low Channel**



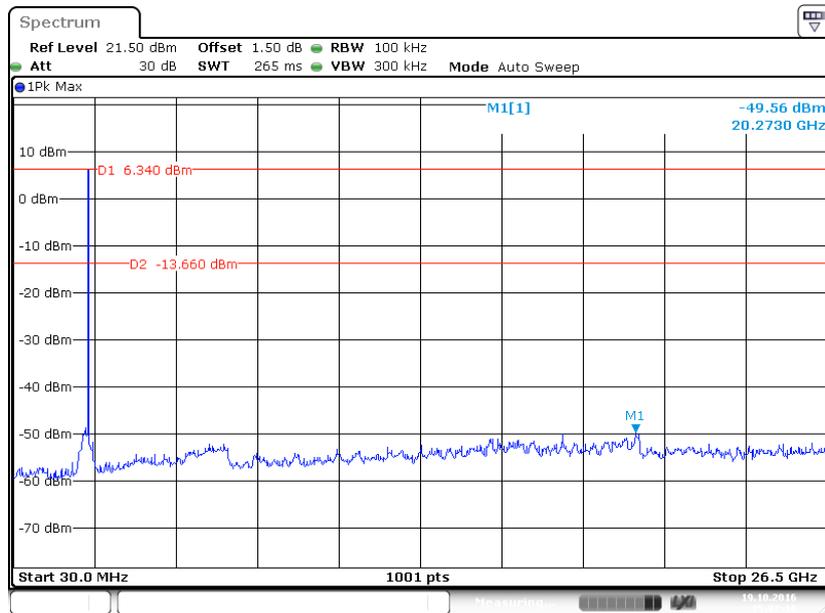
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**Chain 0 802.11b Middle Channel**



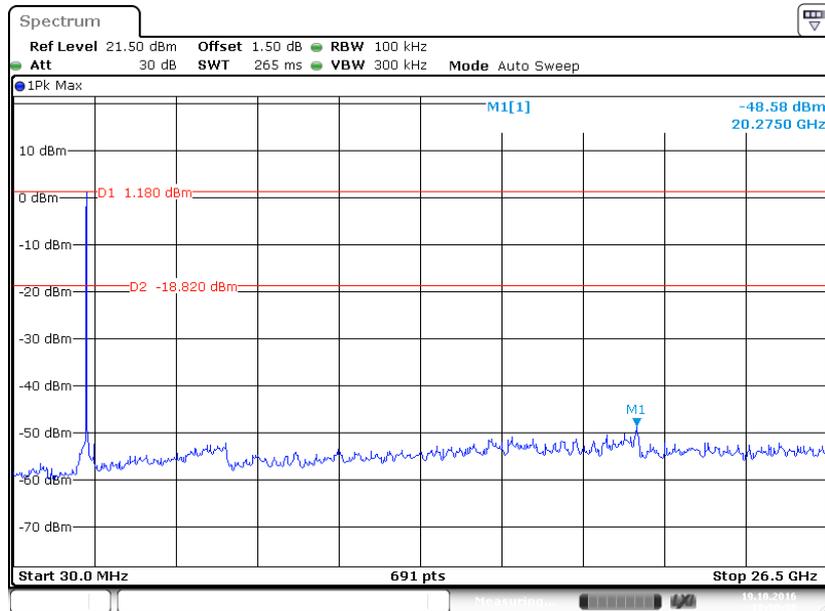
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### Chain 0 802.11b High Channel



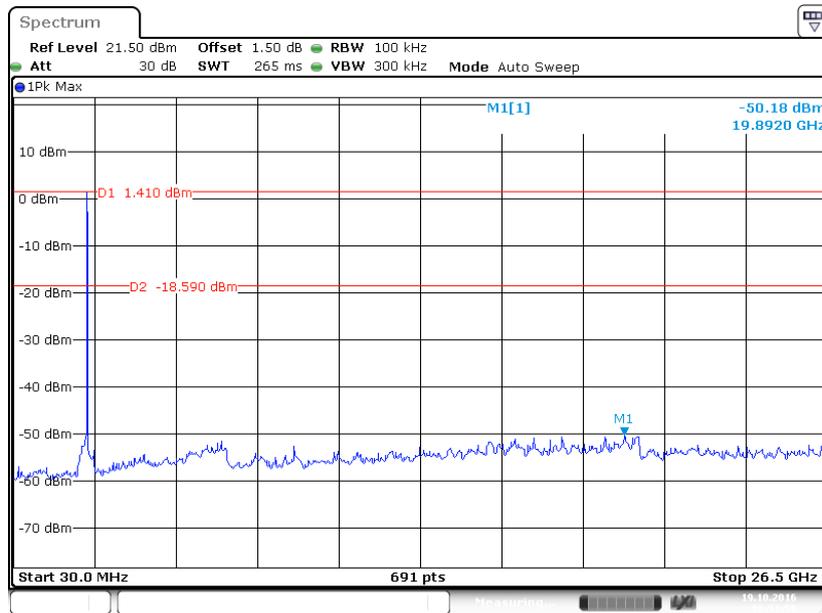
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### Chain 0 802.11g Low Channel

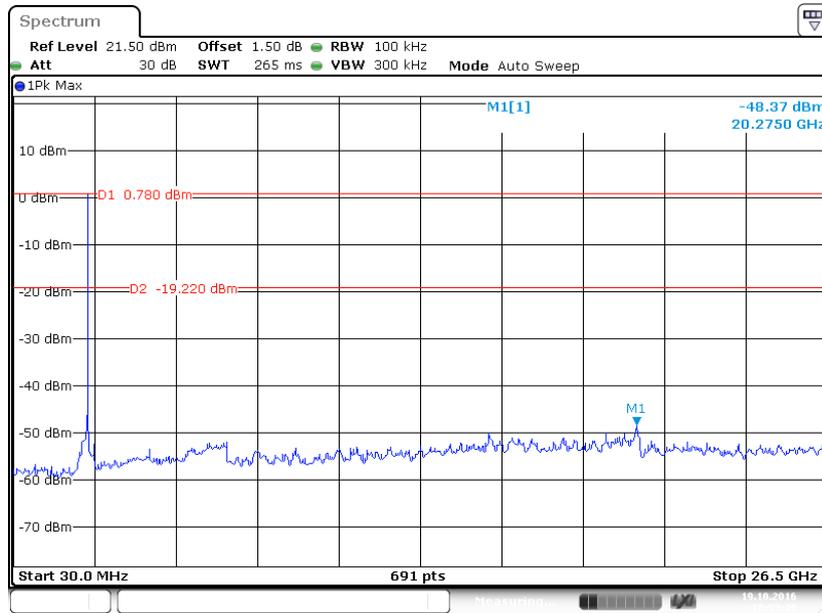


Date: 19.OCT.2016 18:50:50

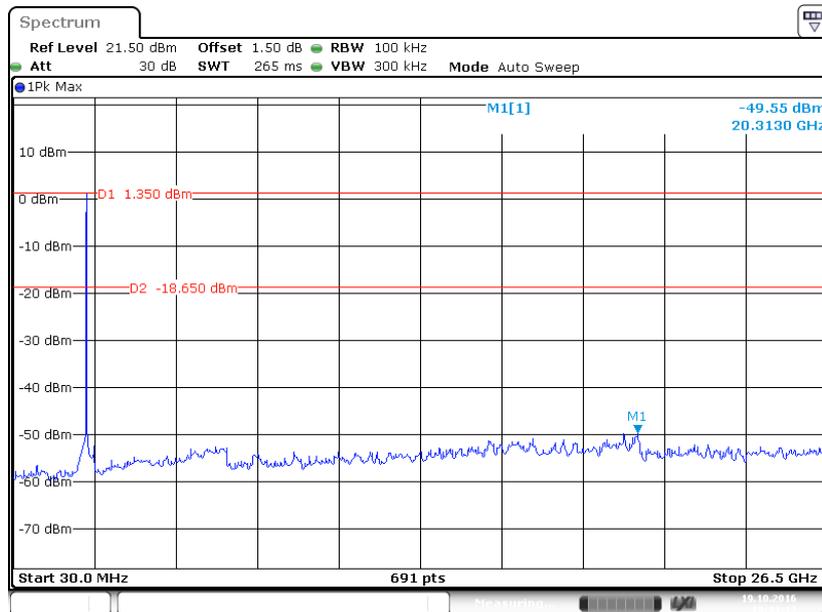
### Chain 0 802.11g Middle Channel



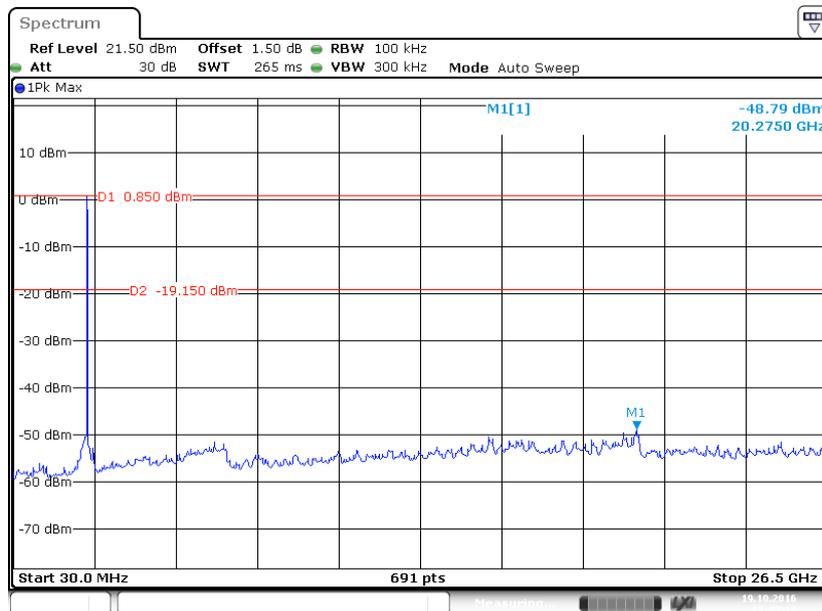
### Chain 0 802.11g High Channel



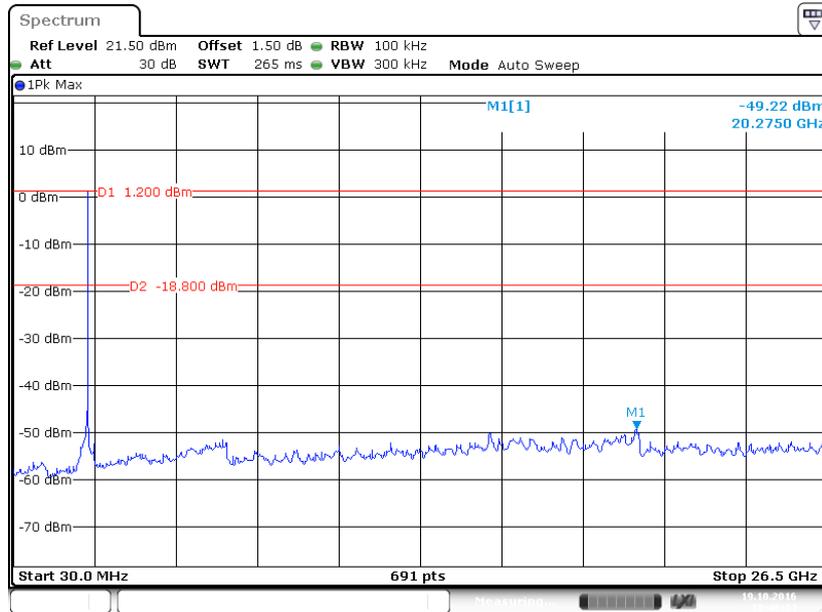
### Chain 0 802.11n-HT20 Low Channel



### Chain 0 802.11n-HT20 Middle Channel

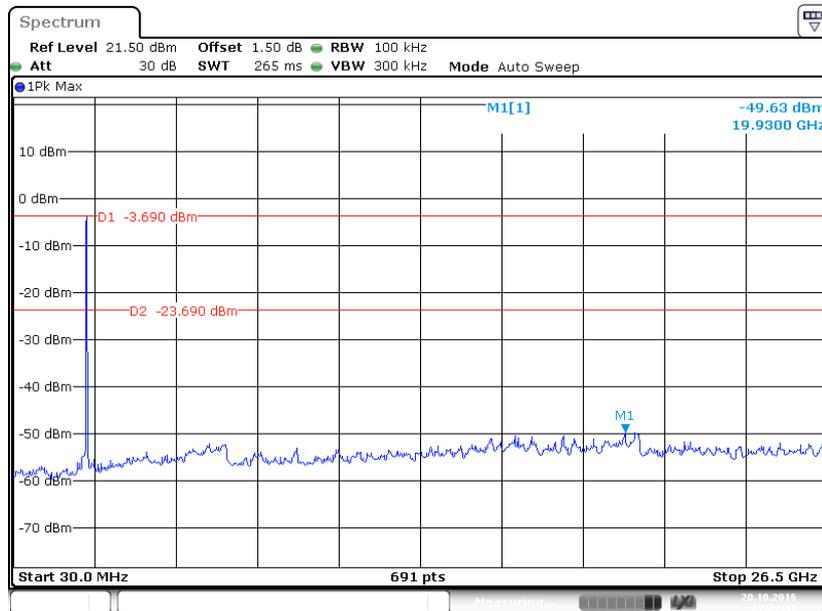


### Chain 0 802.11n-HT20 High Channel



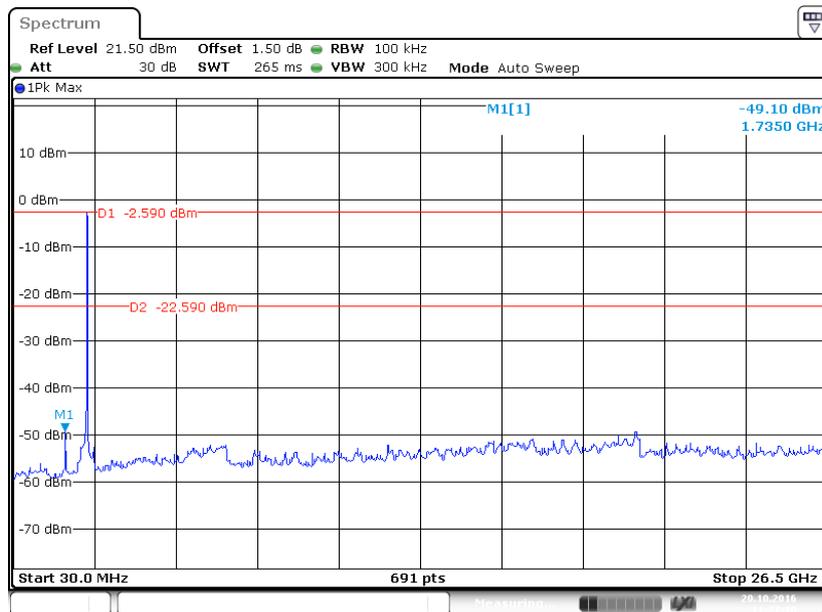
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### Chain 0 802.11n-HT40 Low Channel

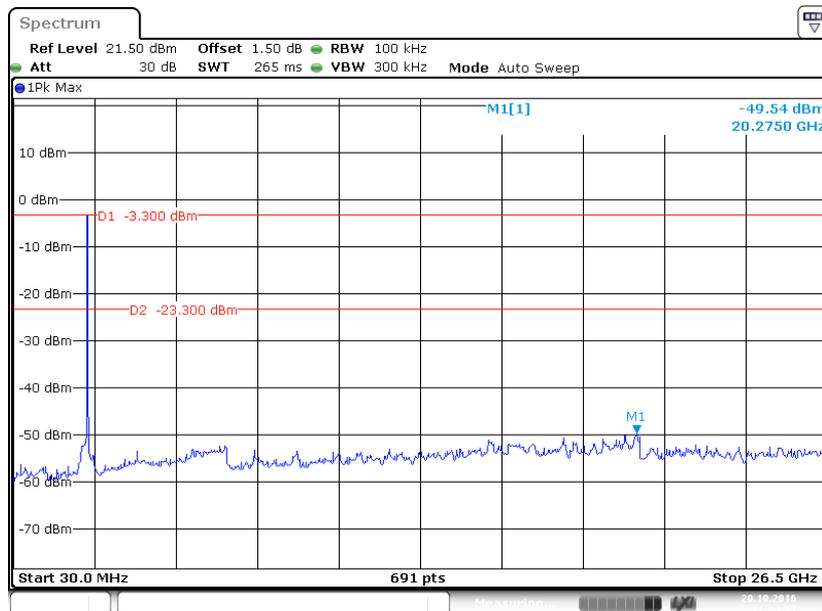


Date: 20.OCT.2016 11:21:47

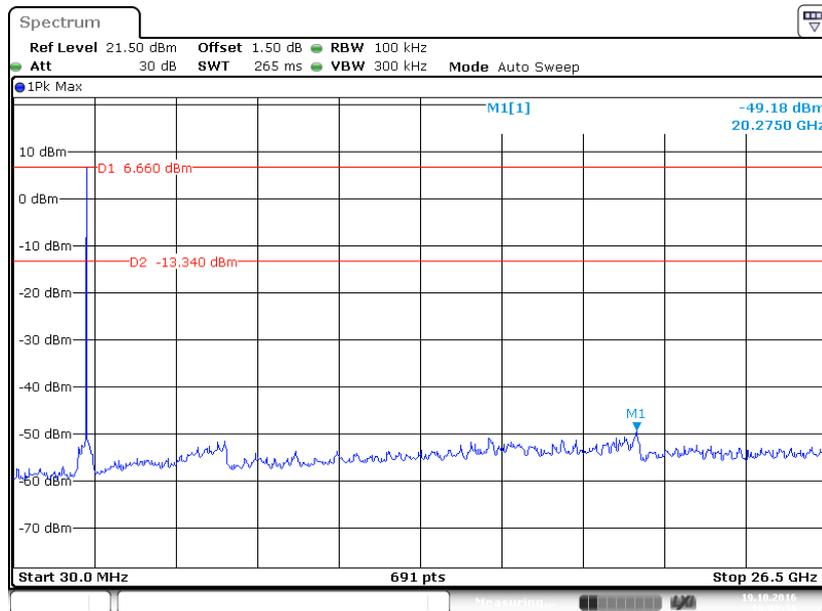
### Chain 0 802.11n-HT40 Middle Channel



### Chain 0 802.11n-HT40 High Channel

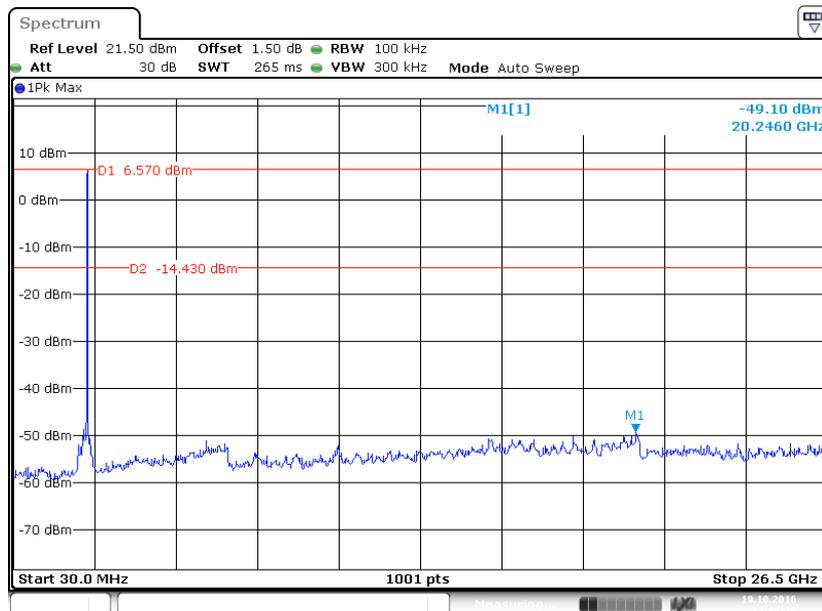


### Chain 1 802.11b Low Channel



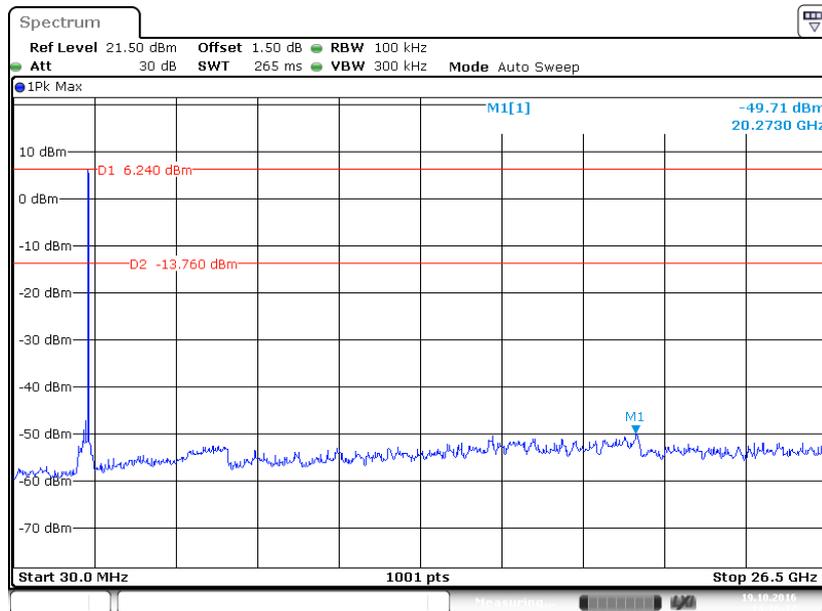
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### Chain 1 802.11b Middle Channel



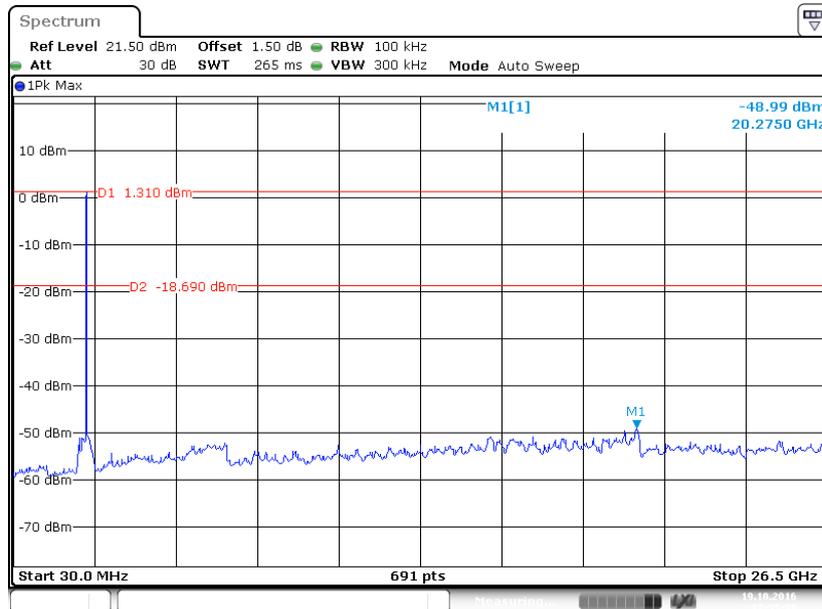
Date: 19.OCT.2016 14:12:26

### Chain 1 802.11b High Channel



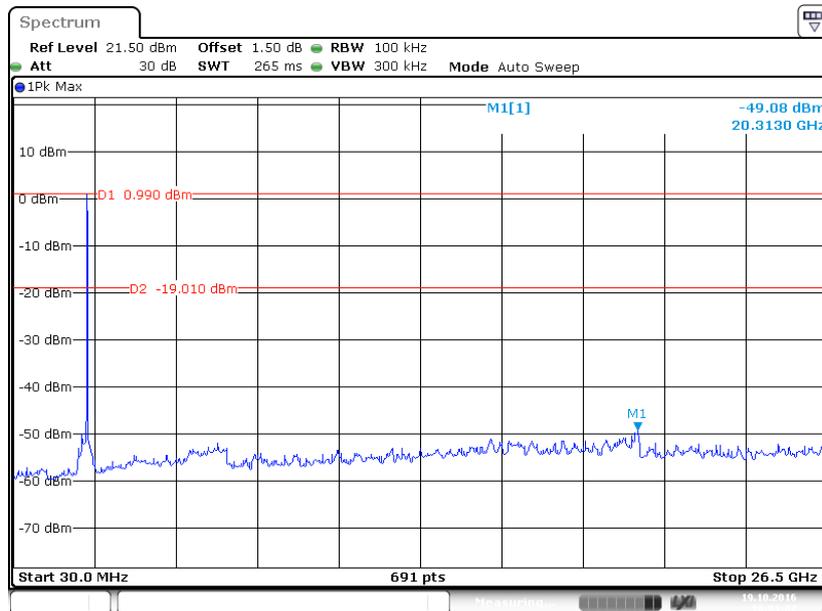
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### Chain 1 802.11g Low Channel

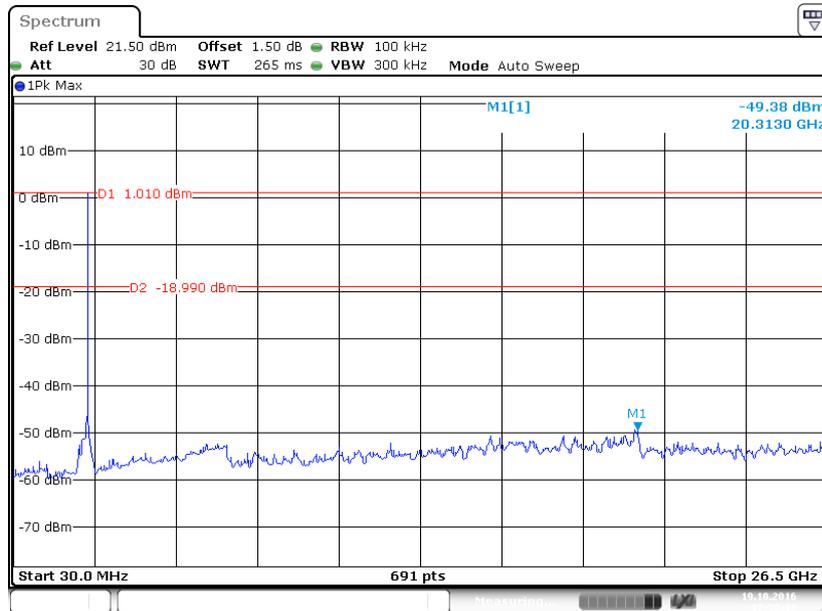


Date: 19.OCT.2016 17:55:38

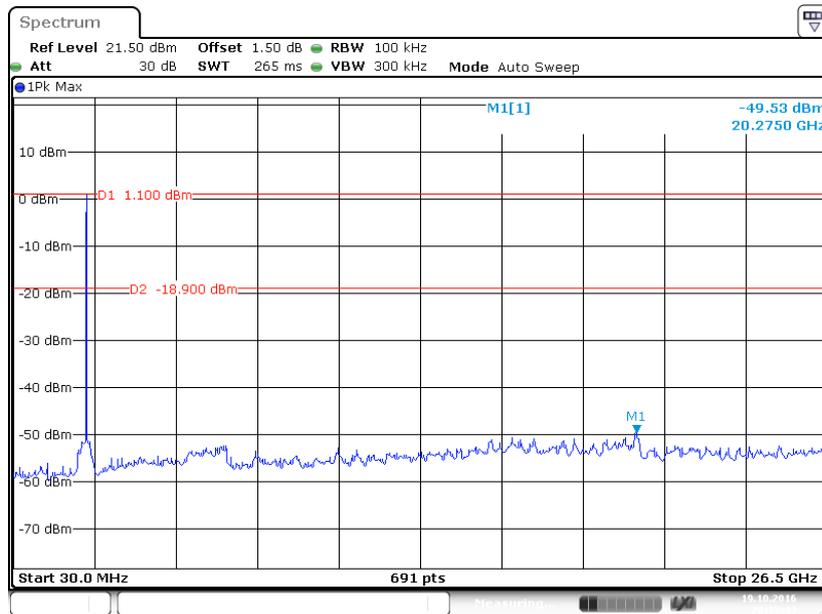
### Chain 1 802.11g Middle Channel



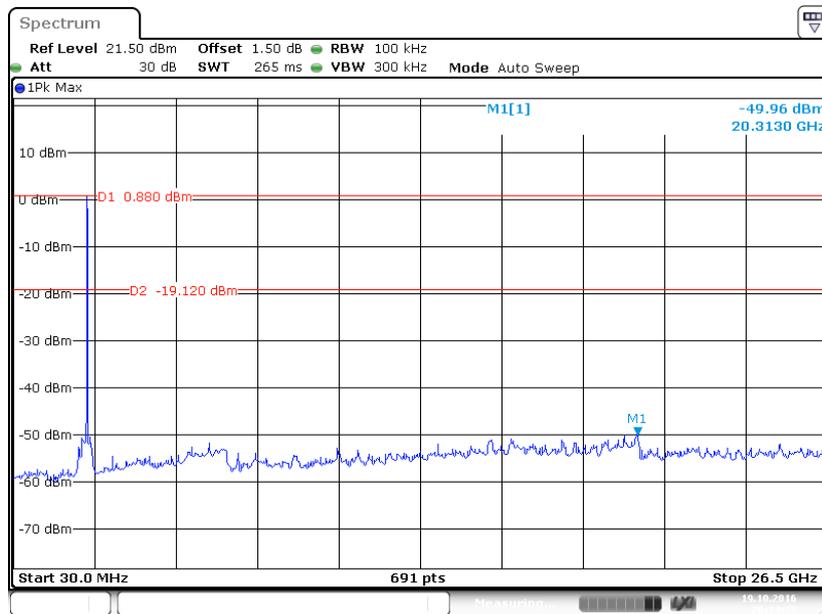
### Chain 1 802.11g High Channel



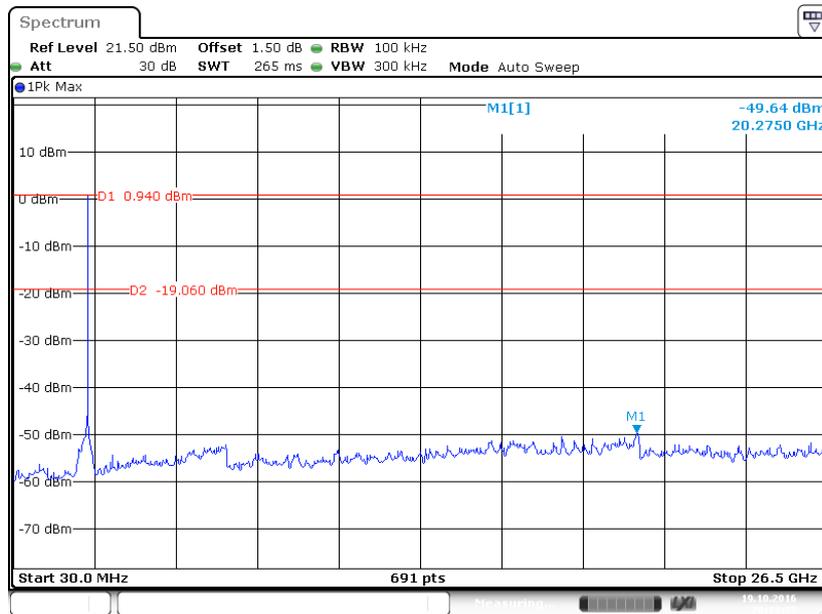
### Chain 1 802.11n-HT20 Low Channel



### Chain 1 802.11n-HT20 Middle Channel

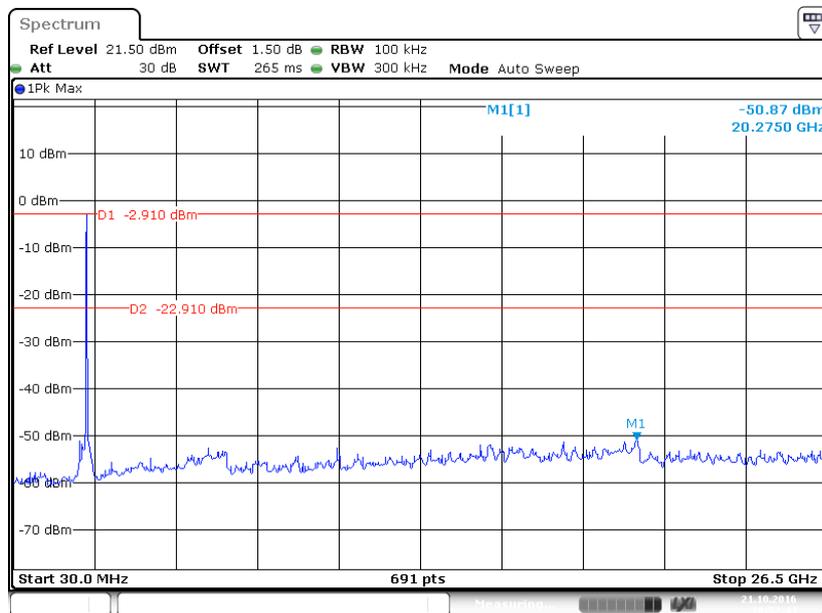


### Chain 1 802.11n-HT20 High Channel



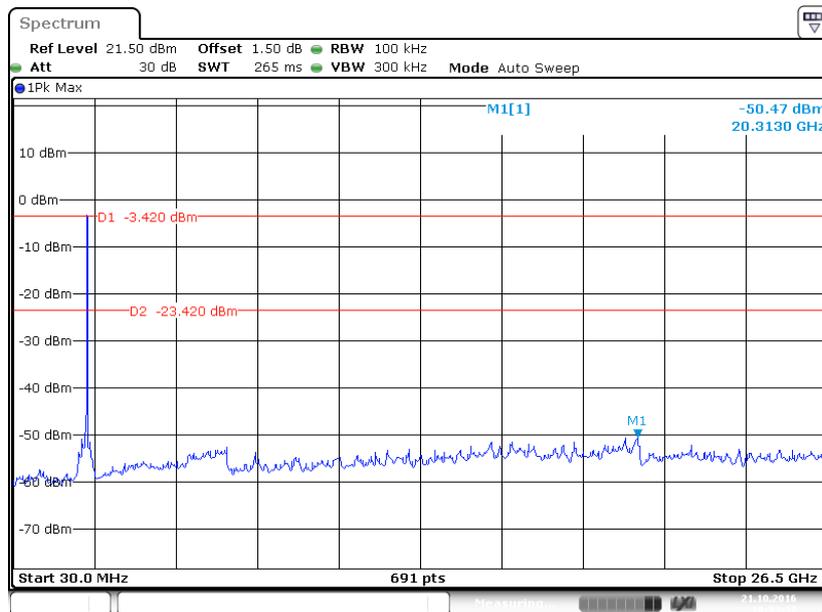
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### Chain 1 802.11n-HT40 Low Channel

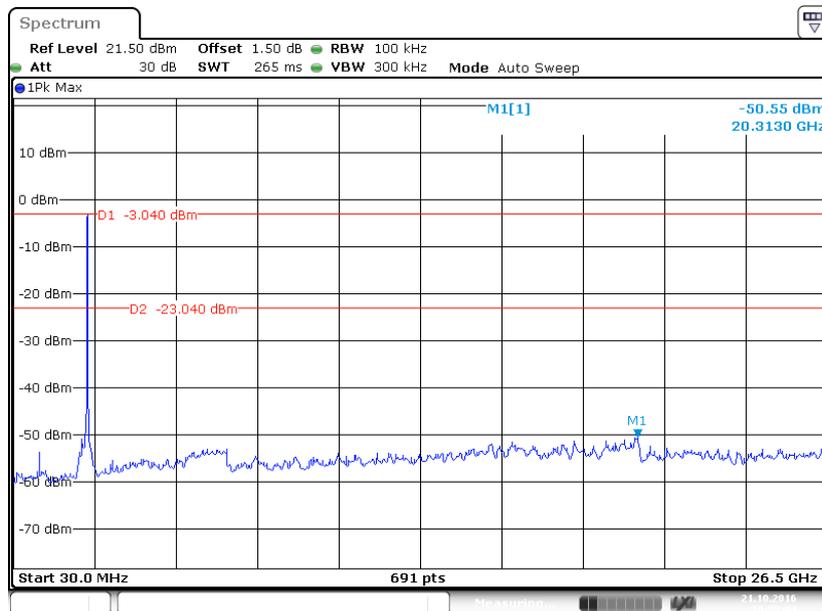


Date: 21.OCT.2016 10:52:44

### Chain 1 802.11n-HT40 Middle Channel



### Chain 1 802.11n-HT40 High Channel



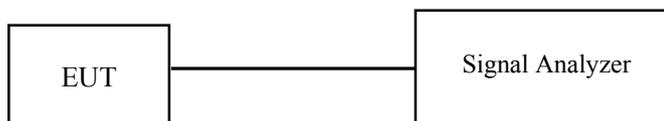
## FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

### Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	SIGNALANALYZER	FSV40	101116	2016-07-04	2017-07-03
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

Temperature:	23 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

*The testing was performed by Edison Hu on 2016-10-19 to 2016-10-21.*

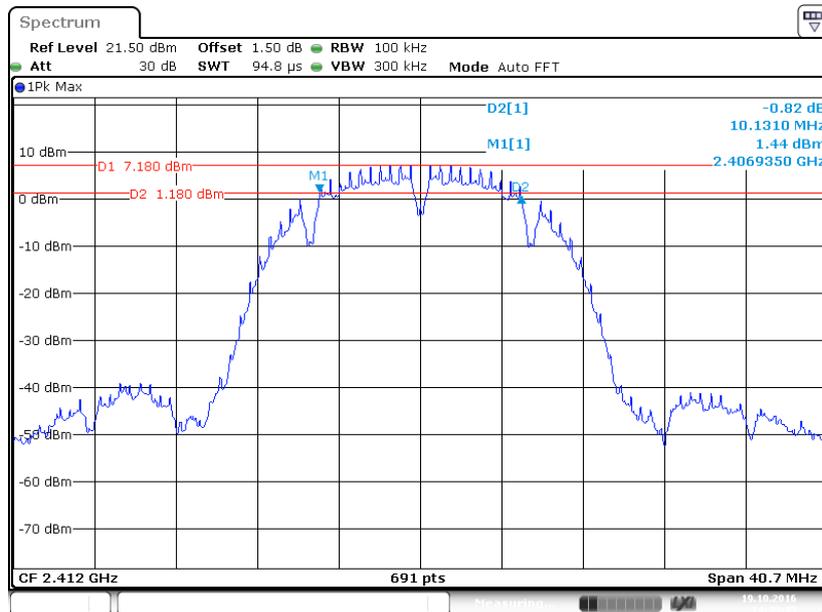
**Test Result:** Pass.

Please refer to the following tables and plots.

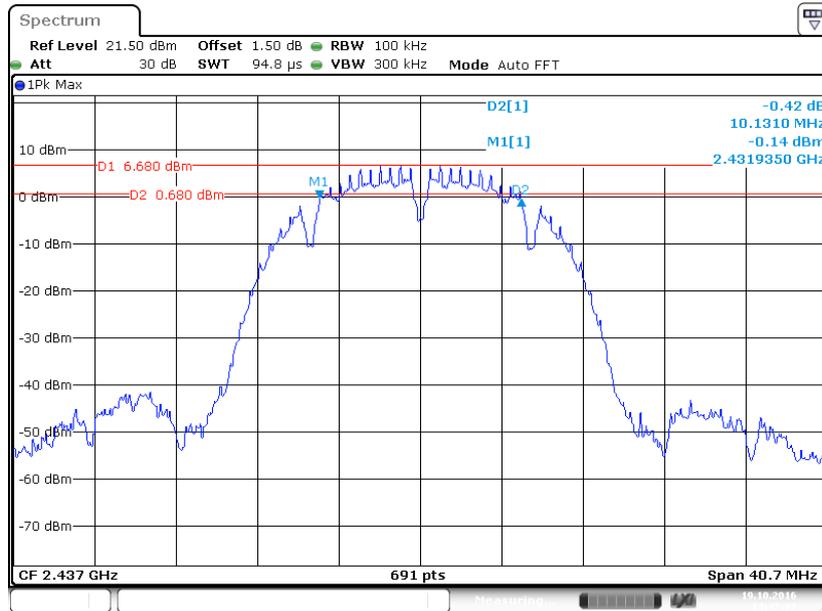
*EUT operation mode: Transmitting(Test only performed at Chain 0)*

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
802.11b			
Low	2412	10.13	≥500
Middle	2437	10.13	≥500
High	2462	10.13	≥500
802.11g			
Low	2412	16.44	≥500
Middle	2437	16.44	≥500
High	2462	16.44	≥500
802.11n-HT20			
Low	2412	17.48	≥500
Middle	2437	17.48	≥500
High	2462	17.48	≥500
802.11n-HT40			
Low	2422	36.35	≥500
Middle	2437	36.35	≥500
High	2452	36.35	≥500

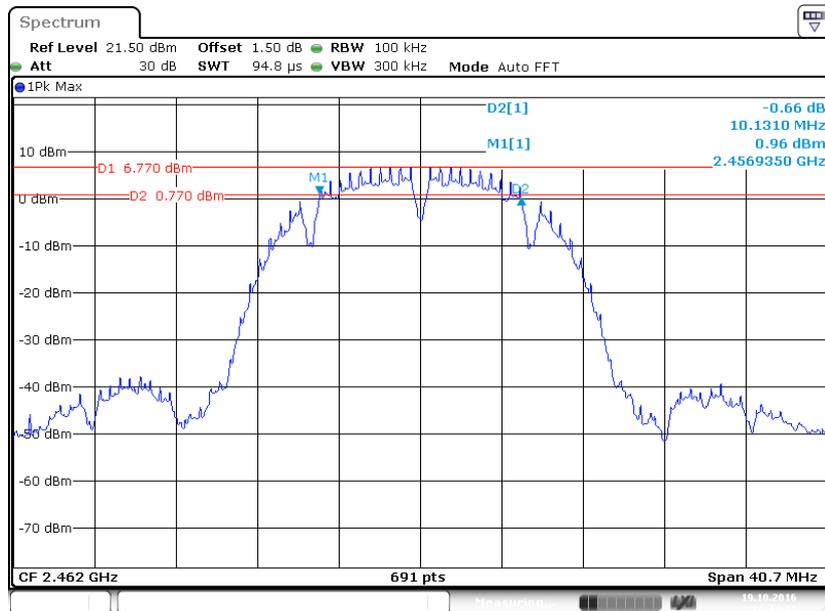
### Chain 0 802.11b Low Channel



### Chain 0 802.11b Middle Channel

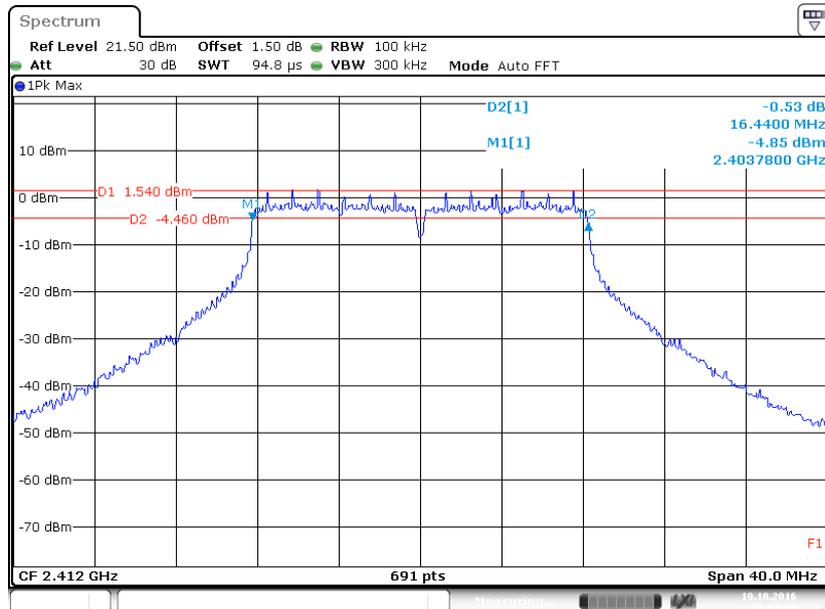


### Chain 0 802.11b High Channel



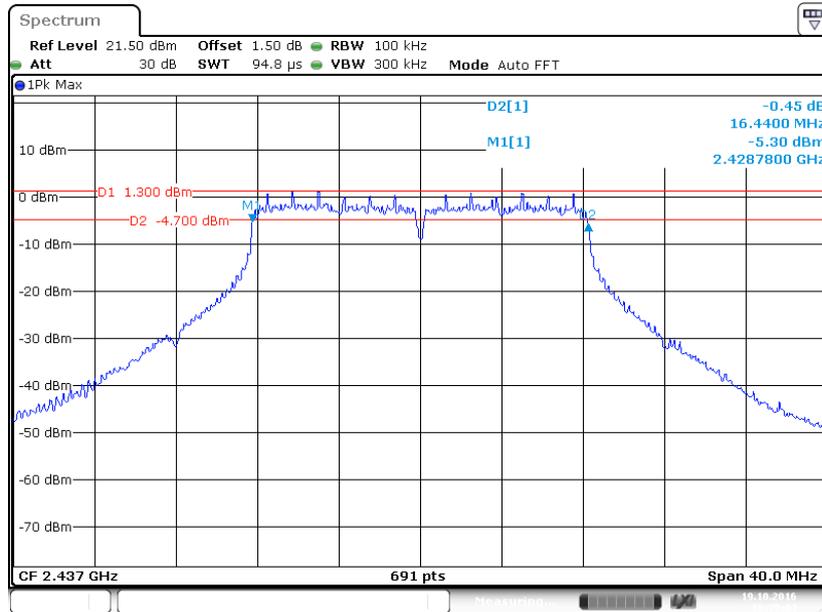
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### Chain 0 802.11g Low Channel



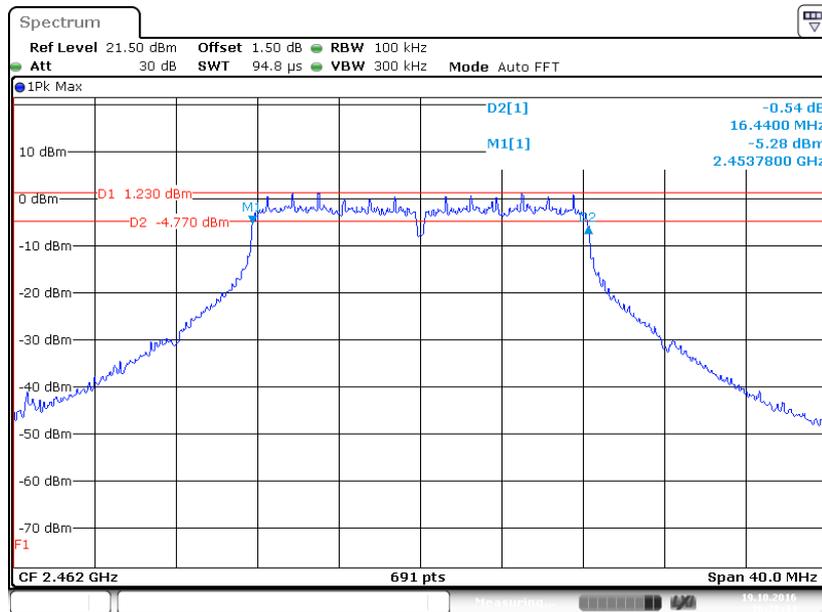
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### Chain 0 802.11g Middle Channel



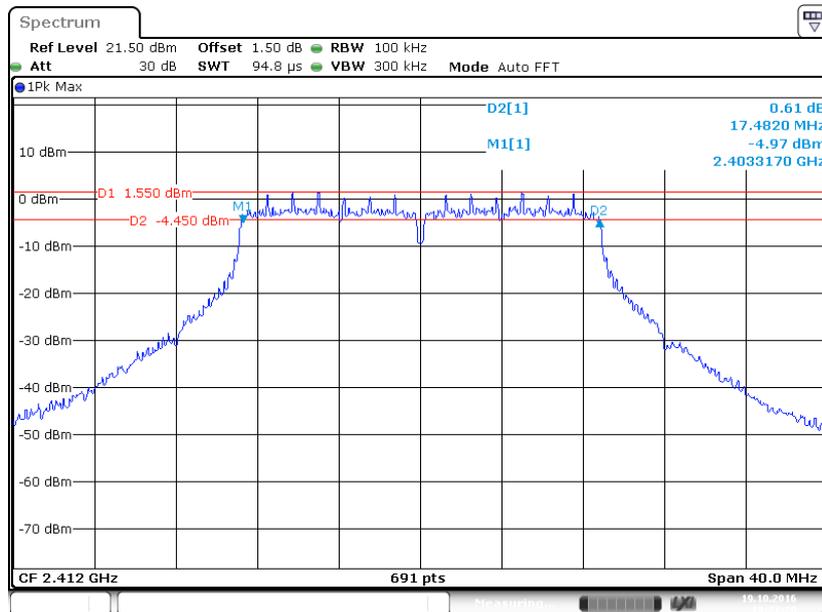
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### Chain 0 802.11g High Channel



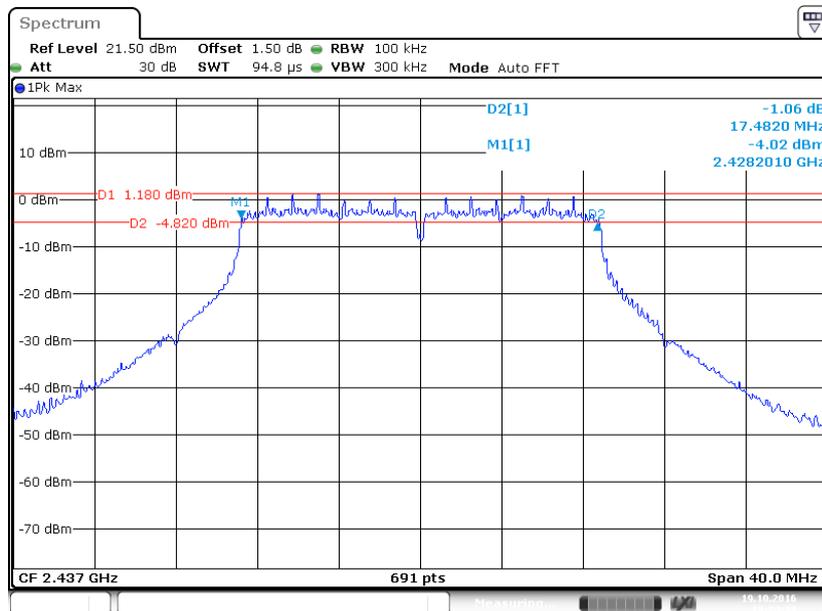
Date: 19.OCT.2016 16:28:44

**Chain 0 802.11n-HT20 Low Channel**



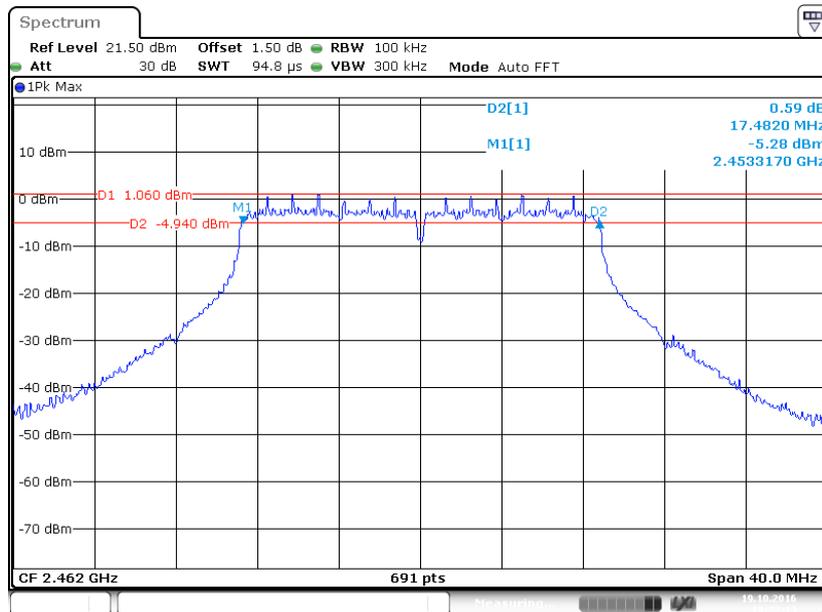
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**Chain 0 802.11n-HT20 Middle Channel**



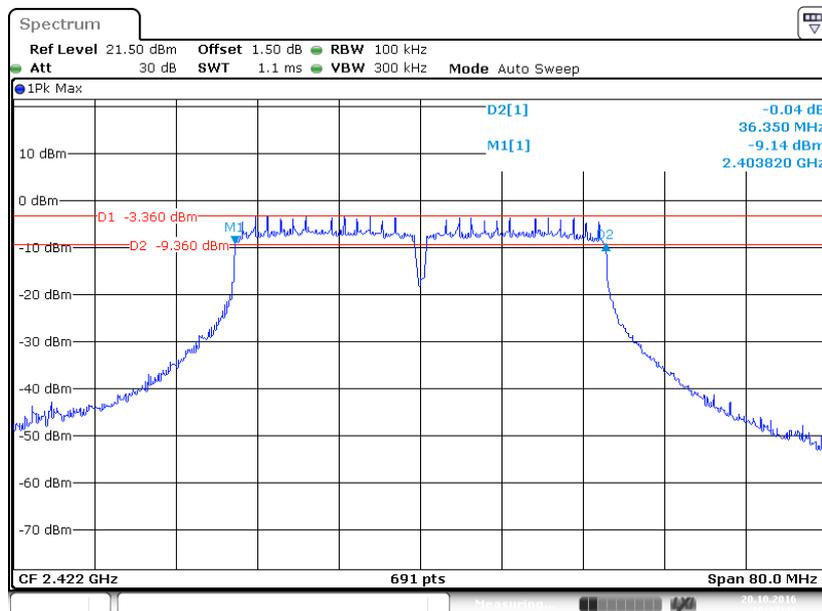
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**Chain 0 802.11n-HT20 High Channel**



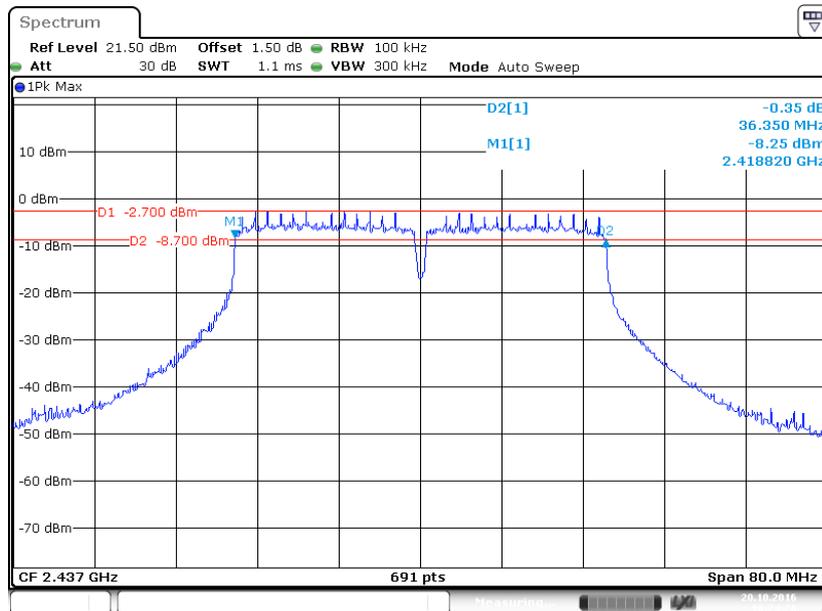
Date: 19.OCT.2016 18:22:13

**Chain 0 802.11n-HT40 Low Channel**

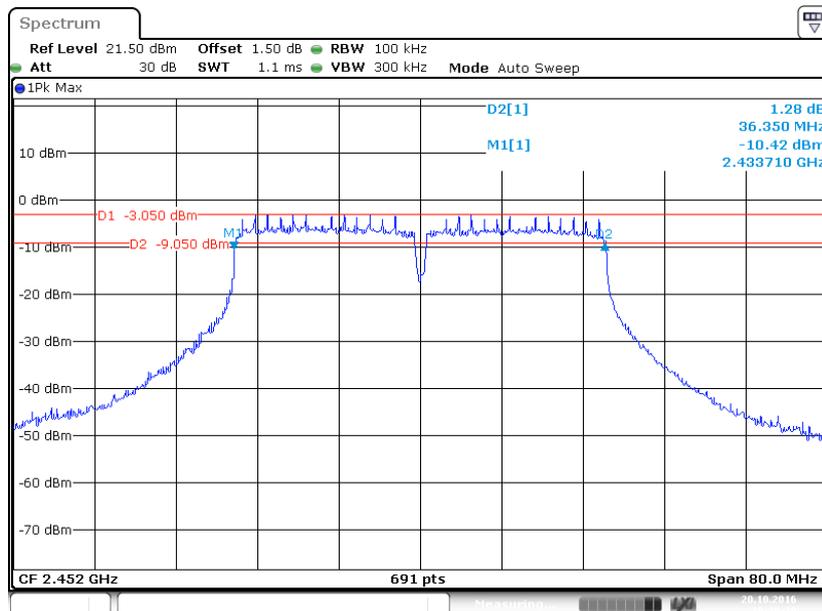


Date: 20.OCT.2016 10:27:47

### Chain 0 802.11n-HT40 Middle Channel



### Chain 0 802.11n-HT40 High Channel



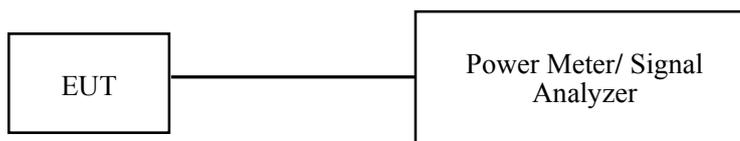
## FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

### Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

### Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	OSP120 BASE UNIT	OSP120	101247	2016-07-04	2017-07-03
Rohde & Schwarz	Power Sensor	NRP-Z91	200014	2016-07-04	2017-07-03
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-11-12	2016-11-11

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Edison Hu on 2016-10-19.*

**Operation mode: Transmitting**

**SISO Mode:**

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)		Limit (dBm)	Result
		Chain 0	Chain 1		
802.11b					
Low	2412	17.89	17.87	30	Pass
Middle	2437	17.52	17.78	30	Pass
High	2462	17.96	17.87	30	Pass
802.11g					
Low	2412	18.65	18.52	30	Pass
Middle	2437	18.80	17.98	30	Pass
High	2462	18.56	17.77	30	Pass
802.11n-HT20					
Low	2412	18.40	17.98	30	Pass
Middle	2437	17.90	17.85	30	Pass
High	2462	17.80	17.89	30	Pass
802.11n-HT40					
Low	2422	16.81	16.72	30	Pass
Middle	2437	16.87	16.63	30	Pass
High	2452	16.76	16.62	30	Pass

Note: The EUT has two PCB antenna arrangement for wifi, the antenna gain are 3.3dBi and 3.8 dBi@2.4GHz band

**2x2 Non-beamforming mode:**

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)			Limit (dBm)	Result
		Chain 0	Chain 1	Total		
802.11b						
Low	2412	17.82	17.82	20.83	30	Pass
Middle	2437	17.56	17.58	20.58	30	Pass
High	2462	17.64	17.51	20.59	30	Pass
802.11g						
Low	2412	18.52	17.98	21.27	30	Pass
Middle	2437	17.78	17.84	20.82	30	Pass
High	2462	18.06	17.70	20.89	30	Pass
802.11n-HT20						
Low	2412	18.23	17.78	21.02	30	Pass
Middle	2437	17.81	17.64	20.74	30	Pass
High	2462	17.68	17.67	20.69	30	Pass
802.11n-HT40						
Low	2422	16.64	16.67	19.67	30	Pass
Middle	2437	16.72	16.54	19.64	30	Pass
High	2452	16.56	16.43	19.51	30	Pass

Note:

The EUT has two PCB antenna arrangement for wifi, the antenna gain are 3.3dBi and 3.8 dBi@2.4GHz band Cyclic Delay Diversity (CDD) was employed by 802.11 MIMO Non-beamforming mode, per C63.10-2013 clause 14.4.3.2.5 a and b, for power measurements on IEEE 802.11 devices:

$$\text{Directional gain} = G_{ant} + \text{array gain}$$

$$\text{Array Gain} = 0 \text{ dB (i.e., no array gain) for } N_{ANT} \leq 4;$$

**2x2 Beamforming mode:**

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)			Limit (dBm)	Result
		Chain 0	Chain 1	Total		
802.11n-HT20						
Low	2412	18.01	17.35	20.70	29.44	Pass
Middle	2437	17.45	17.24	20.36	29.44	Pass
High	2462	17.38	17.28	20.34	29.44	Pass
802.11n-HT40						
Low	2422	16.43	16.34	19.40	29.44	Pass
Middle	2437	16.37	16.23	19.31	29.44	Pass
High	2452	16.31	16.19	19.26	29.44	Pass

Note:

The EUT has two PCB antenna arrangement for wifi, the antenna gain are 3.3dBi and 3.8 dBi@2.4GHz band  
 For beamforming mode, C63.10-2013 clause 14.4.3.2.3, power measurements on IEEE 802.11 devices:

a) If transmit signals are correlated, then:

$$\text{Directional gain} = 10 \log \left[ \frac{\left( 10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20} \right)^2}{N_{\text{ANT}}} \right] \text{ dBi}$$

$$\text{Directional Gain} = 10 * \log \left[ \frac{(10^{3.3/20} + 10^{3.8/20})^2}{2} \right] = 6.56 \text{ dBi}$$

Power limit was reduced by 0.56dBi

## **FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE**

### **Applicable Standard**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### **Test Equipment List and Details**

<b>Manufacturer</b>	<b>Description</b>	<b>Model</b>	<b>Serial Number</b>	<b>Calibration Date</b>	<b>Calibration Due Date</b>
Rohde & Schwarz	SIGNALANALYZER	FSV40	101116	2016-07-04	2017-07-03
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Edison Hu on 2016-10-19 to 2016-10-20.

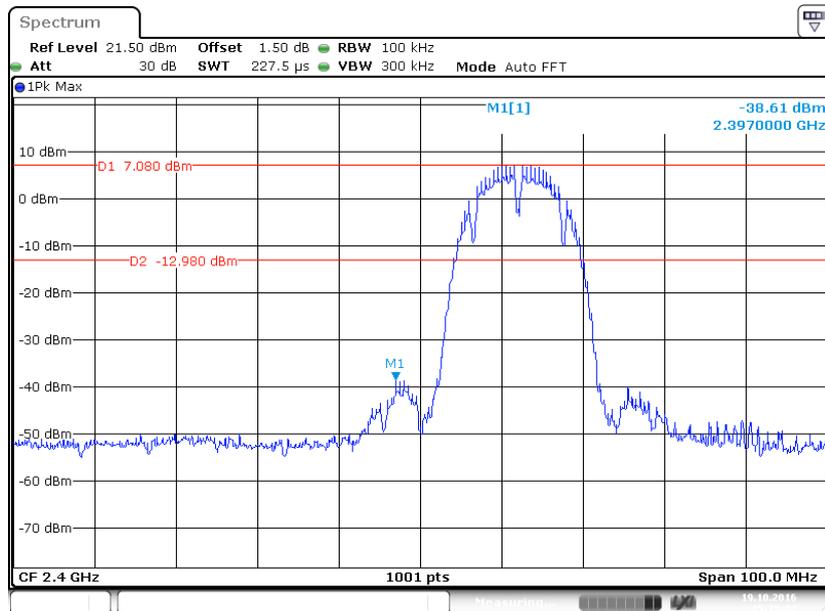
**Test Result: Compliance**

(SISO mode was selected for testing since SISO mode was the maximum power per chain)

Please refer to the following table and plots.

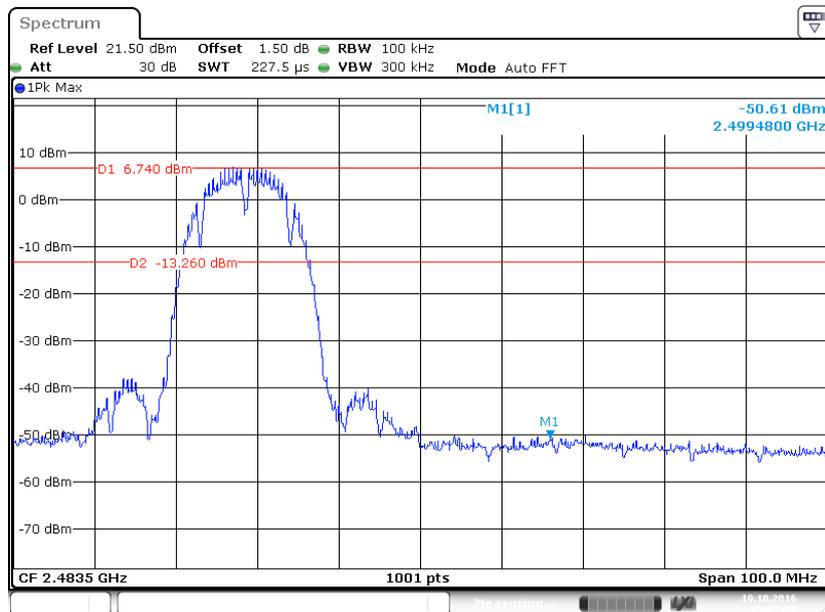
Antenna Chain	Test Mode	Bandedge	Fundamental Level (dBm/100kHz)	Worst Bandedge Level (dBm/100kHz)	Delta (dBc)	Limits (dBc)
0	802.11b	Left	7.08	-38.61	45.69	30
		Right	6.74	-50.61	57.35	30
	802.11g	Left	1.60	-29.26	30.86	30
		Right	1.08	-51.23	52.31	30
	802.11n ht20	Left	1.56	-28.57	30.13	30
		Right	1.04	-48.71	49.75	30
802.11n ht40	Left	-3.11	-33.21	30.1	30	
	Right	-3.34	-47.01	43.67	30	
1	802.11b	Left	6.90	-39.77	46.67	30
		Right	6.68	-48.39	55.07	30
	802.11g	Left	1.26	-30.20	31.46	30
		Right	0.61	-50.25	50.86	30
	802.11n ht20	Left	1.24	-29.96	31.2	30
		Right	0.65	-40.96	41.61	30
802.11n ht40	Left	-3.32	-33.62	30.3	30	
	Right	-3.11	-45.98	42.87	30	

### Chain 0 802.11b: Band Edge, Left Side



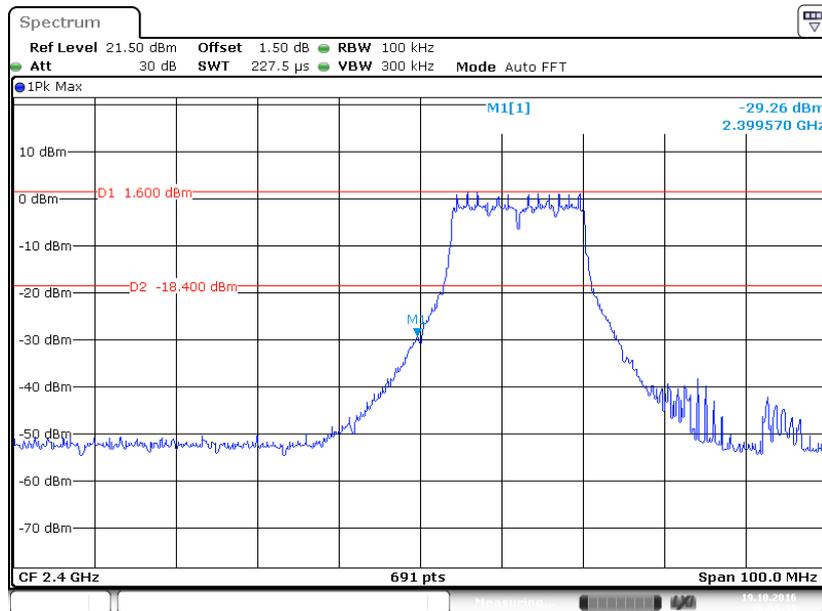
Date: 19.OCT.2016 15:15:02

### Chain 0 802.11b: Band Edge, Right Side

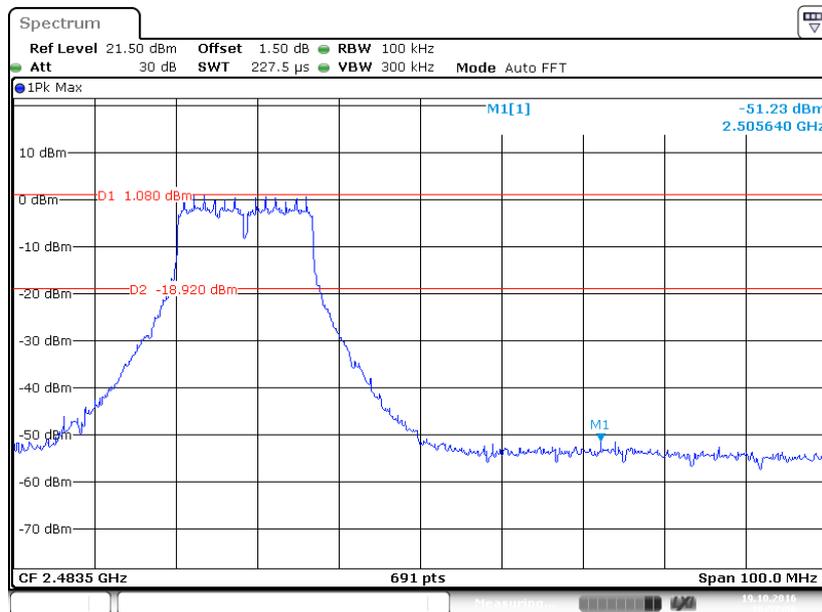


Date: 19.OCT.2016 15:12:50

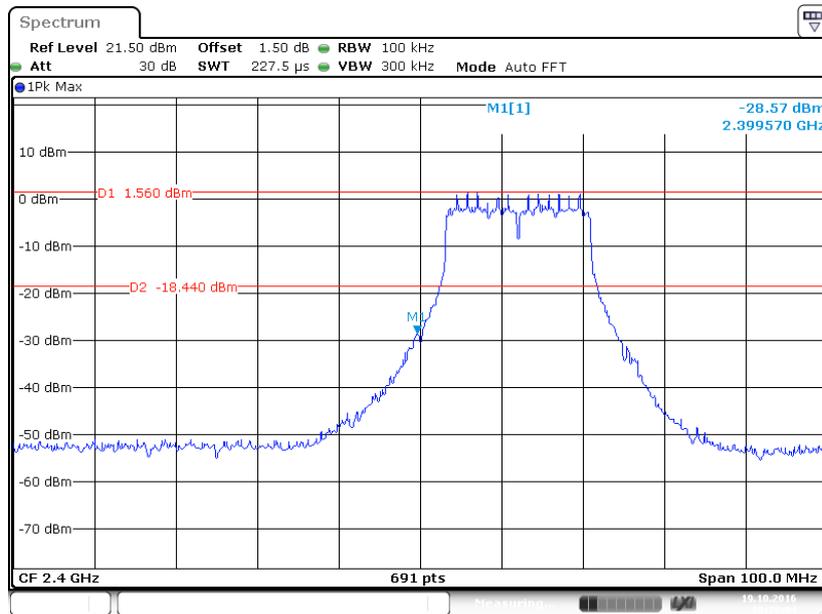
### Chain 0 802.11g: Band Edge, Left Side



### Chain 0 802.11g: Band Edge, Right Side

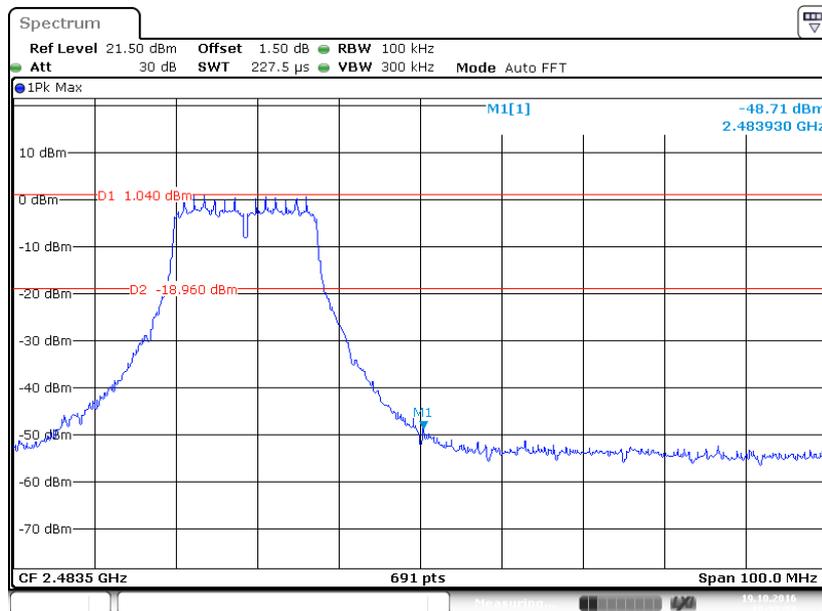


### Chain 0 802.11n-HT20: Band Edge, Left Side



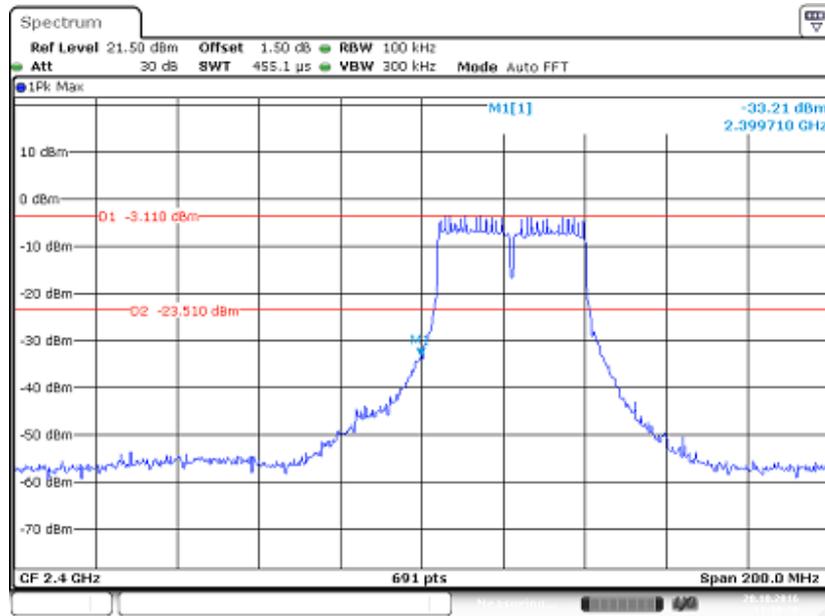
Date: 19.OCT.2016 18:38:04

### Chain 0 802.11n-HT20: Band Edge, Right Side



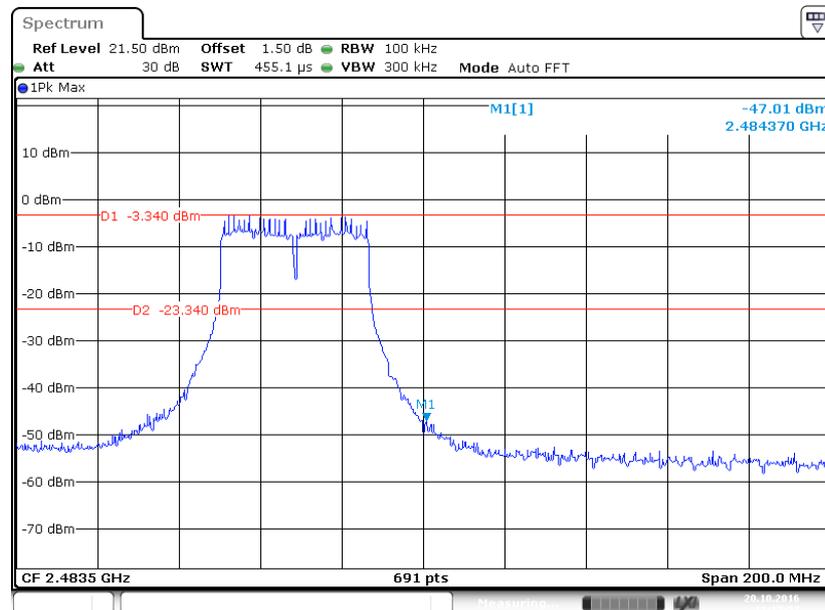
Date: 19.OCT.2016 18:35:59

### Chain 0 802.11n-HT40: Band Edge, Left Side



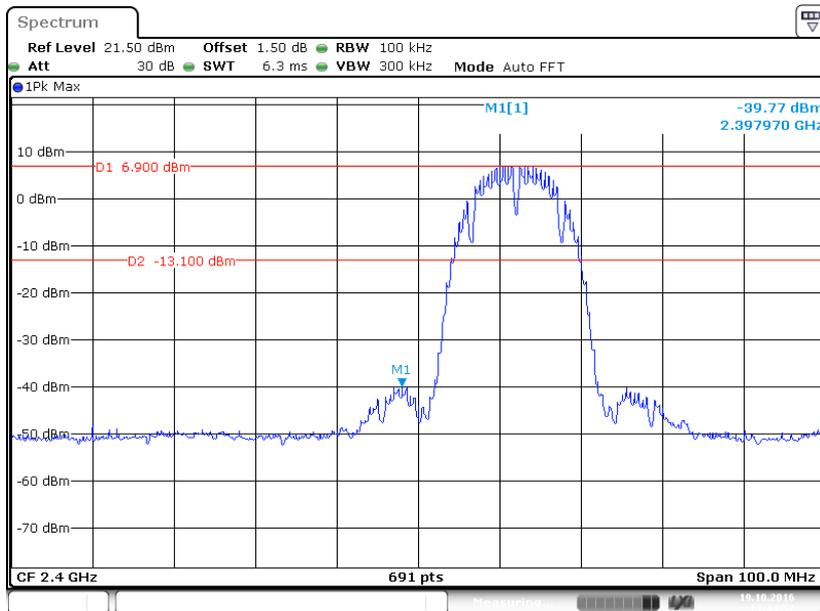
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### Chain 0 802.11n-HT40: Band Edge, Right Side



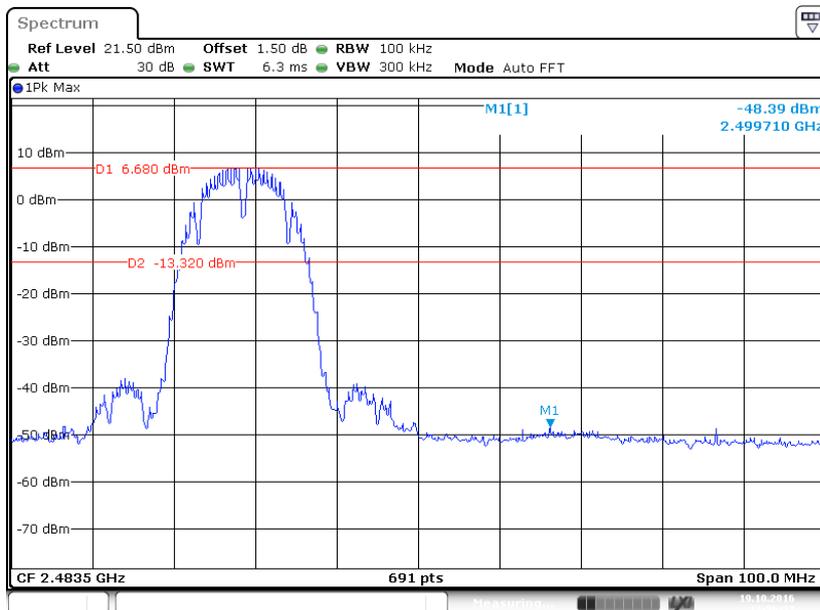
Date: 20.OCT.2016 11:35:58

### Chain 1 802.11b: Band Edge, Left Side



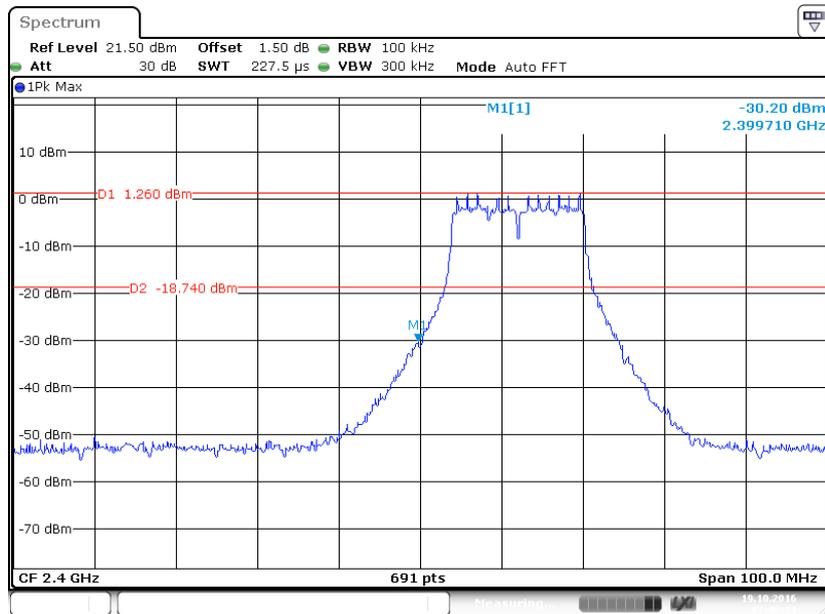
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### Chain 1 802.11b: Band Edge, Right Side



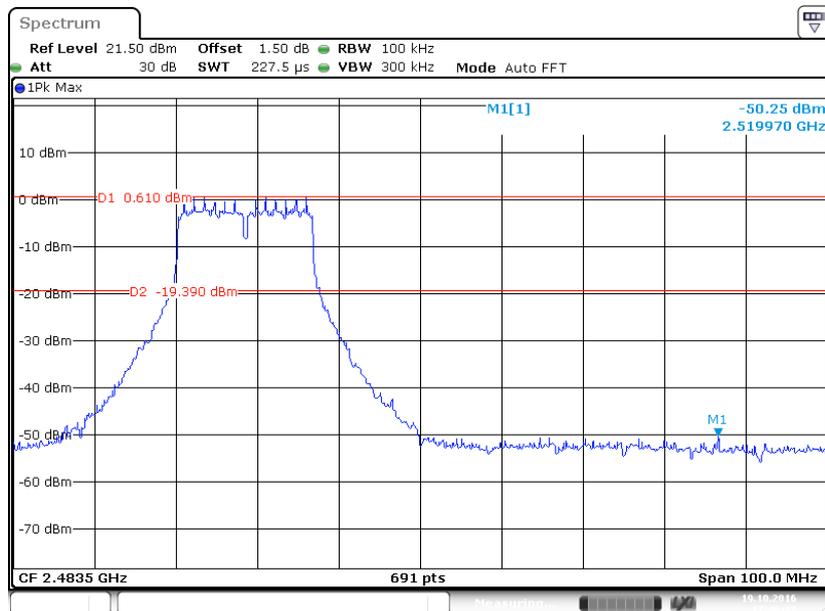
Date: 19.OCT.2016 13:56:27

### Chain 1 802.11g: Band Edge, Left Side



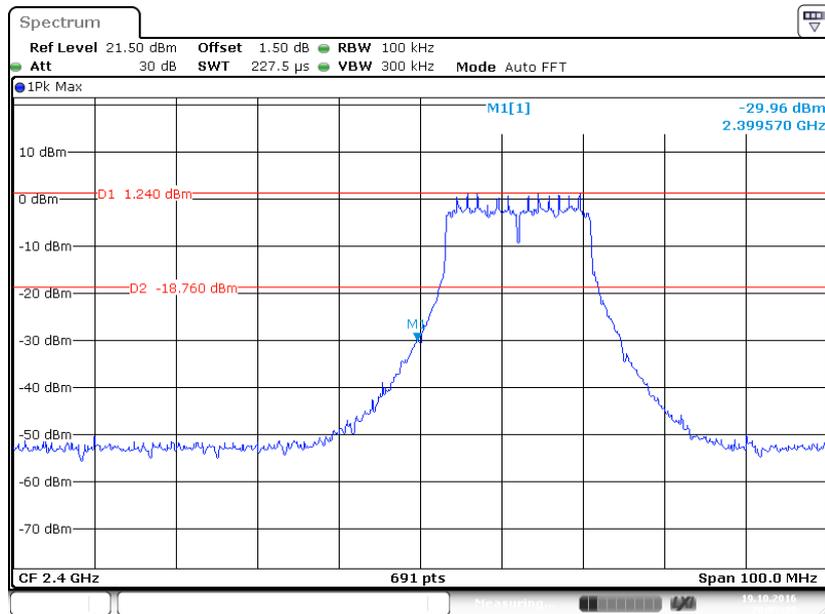
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### Chain 1 802.11g: Band Edge, Right Side

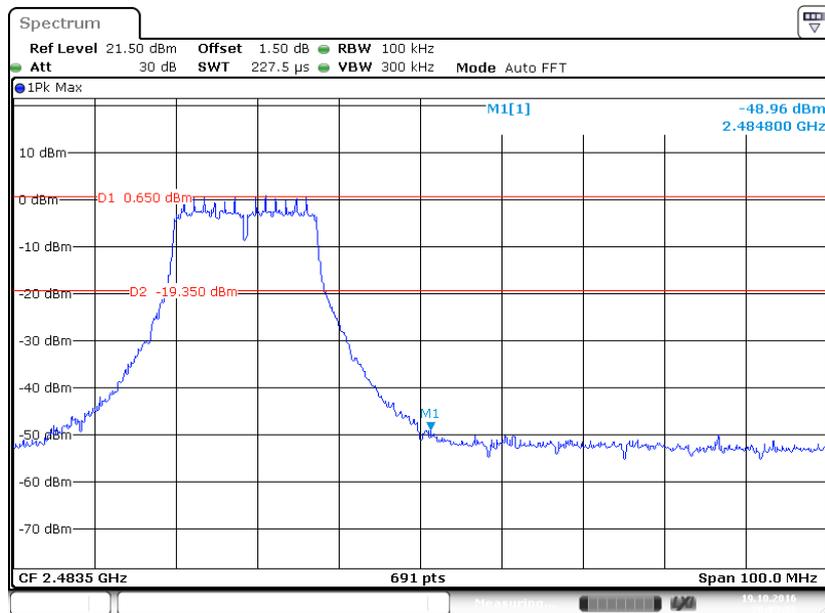


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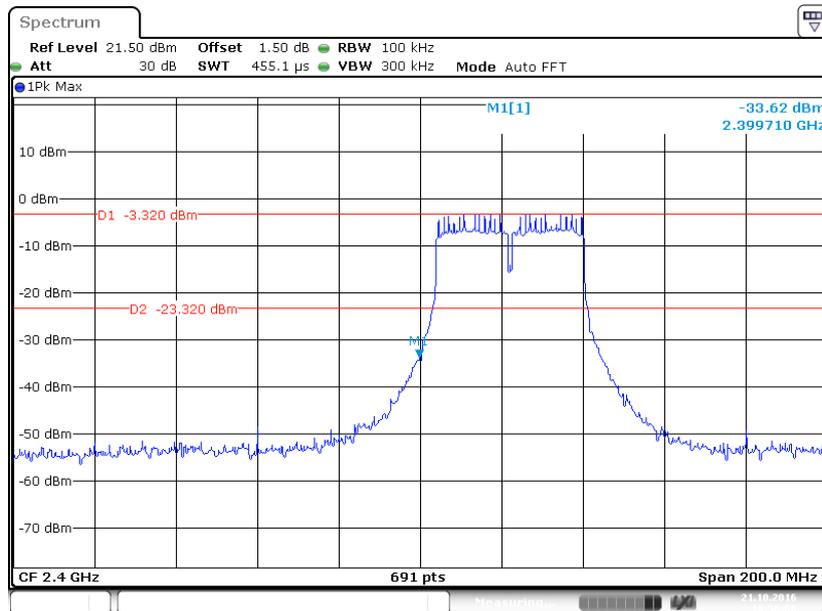
**Chain 1 802.11n-HT20: Band Edge, Left Side**



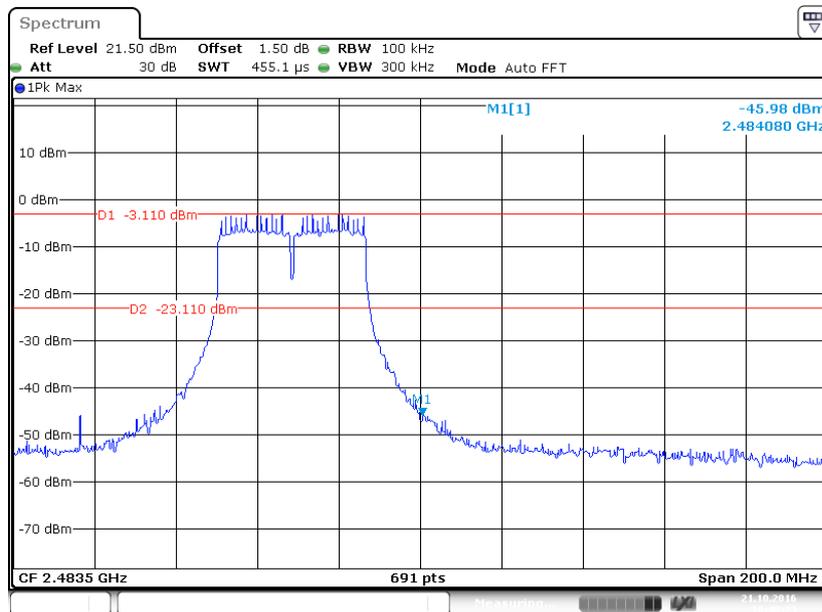
**Chain1 802.11n-HT20: Band Edge, Right Side**



### Chain 1 802.11n-HT40: Band Edge, Left Side



### Chain 1 802.11n-HT40: Band Edge, Right Side



## FCC §15.247(e) - POWER SPECTRAL DENSITY

### Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### Test Procedure

According to KDB558074 D01 DTS Meas Guidance v03r05 sub-clause 10.2

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to:  $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$ .
3. Set the VBW  $\geq 3 \times \text{RBW}$ .
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	SIGNALANALYZER	FSV40	101116	2016-07-04	2017-07-03
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

Temperature:	23 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Edison Hu on 2016-10-19 to 2016-11-06.

EUT operation mode: Transmitting

**Test Result:** Pass (SISO mode was the maximum power mode per chain, so the MIMO modes PSD is less than SISO mode per chain)

Channel	Frequency (MHz)	PSD (dBm/3kHz)			Limit (dBm/3kHz)
		Chain 0	Chain 1	Total	
802.11b					
Low	2412	-7.38	-7.71	-4.53	≤7.44
Middle	2437	-7.65	-7.48	-4.55	≤7.44
High	2462	-7.79	-7.91	-4.84	≤7.44
802.11g					
Low	2412	-11.29	-11.00	-8.13	≤7.44
Middle	2437	-11.24	-11.72	-8.46	≤7.44
High	2462	-11.36	-11.69	-8.51	≤7.44
802.11n-HT20					
Low	2412	-11.70	-11.99	-8.83	≤7.44
Middle	2437	-12.44	-12.29	-9.35	≤7.44
High	2462	-12.11	-12.53	-9.30	≤7.44
802.11n-HT40					
Low	2422	-14.85	-15.17	-12.00	≤7.44
Middle	2437	-14.58	-15.71	-12.10	≤7.44
High	2452	-14.62	-14.91	-11.75	≤7.44

Note:

The strict limit was the used for compliance evaluation.

The EUT has two PCB antenna arrangement for wifi, the antenna gain are 3.3dBi and 3.8 [dBi@2.4GHz](#) band

For beamforming mode, C63.10-2013 clause 14.4.3.2.3, power measurements on IEEE 802.11 devices:

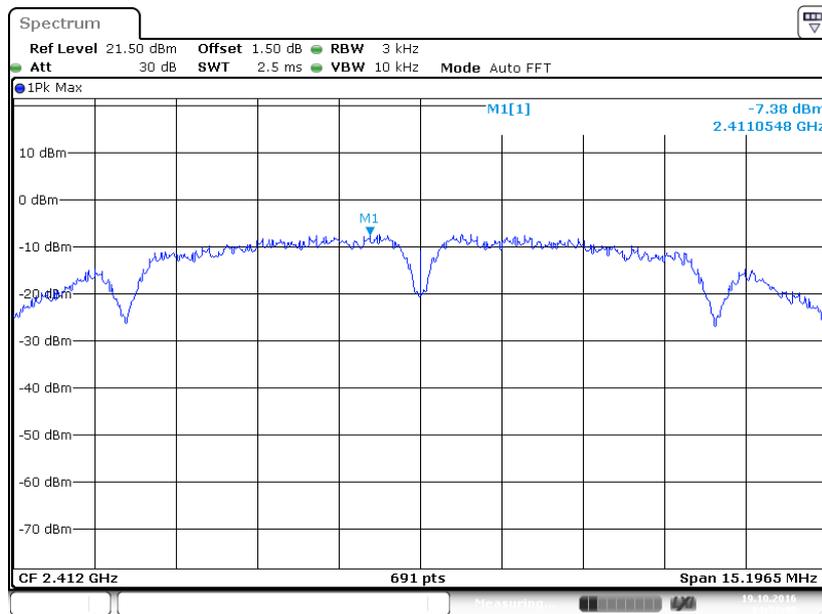
a) If transmit signals are correlated, then:

$$\text{Directional gain} = 10 \log \left[ \frac{\left( 10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20} \right)^2}{N_{\text{ANT}}} \right] \text{ dBi}$$

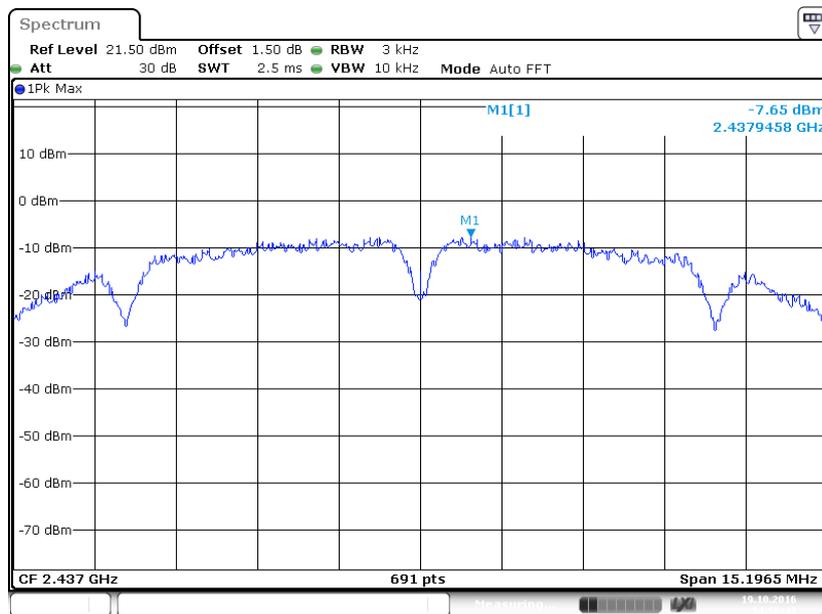
Directional Gain=  $10 * \log[(10^{3.3/20} + 10^{3.8/20})^2 / 2] = 6.56 \text{ dBi}$

Power limit was reduced by 0.56dBi

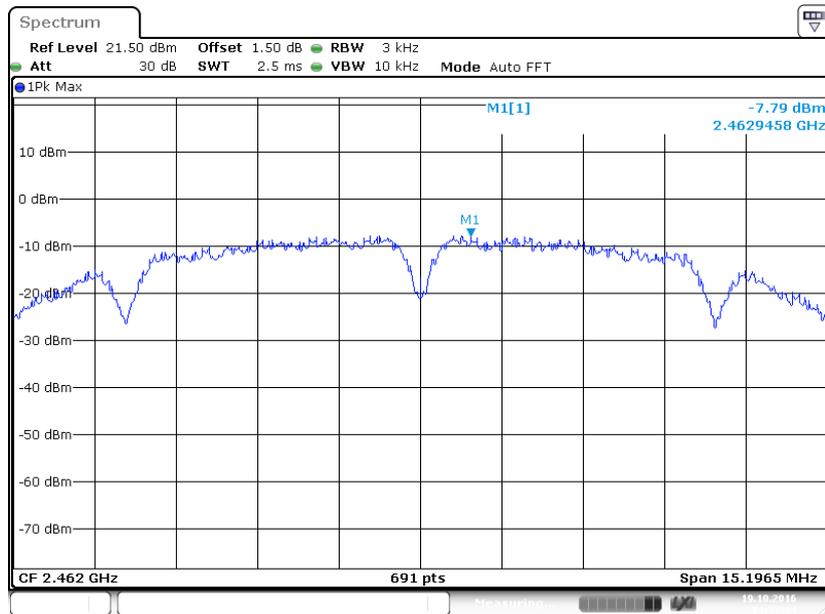
### Chain 0 Power Spectral Density, 802.11b Low Channel



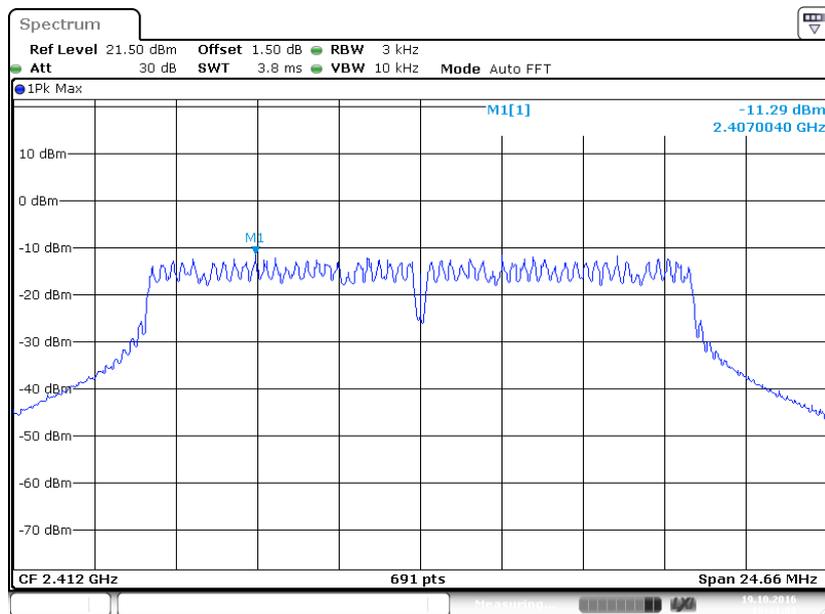
### Chain 0 Power Spectral Density, 802.11b Middle Channel



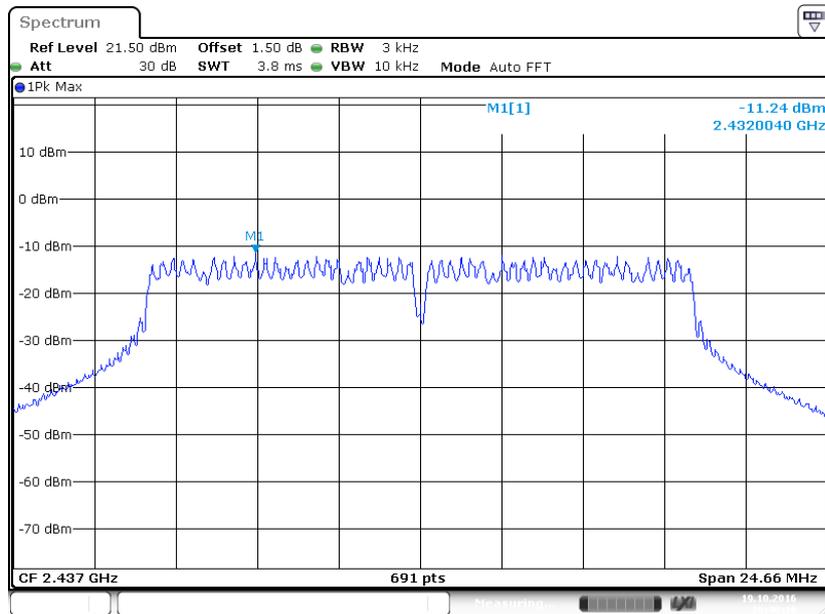
### Chain 0 Power Spectral Density, 802.11b High Channel



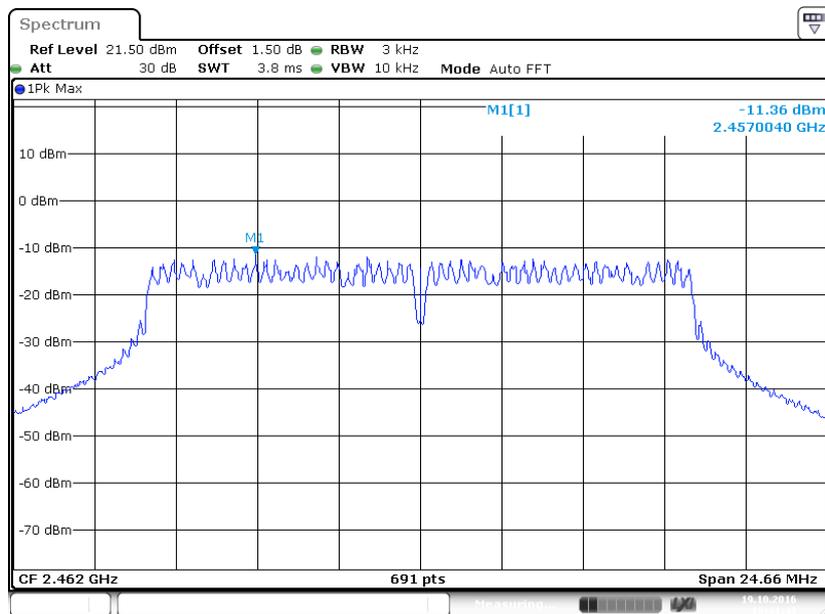
### Chain 0 Power Spectral Density, 802.11g Low Channel



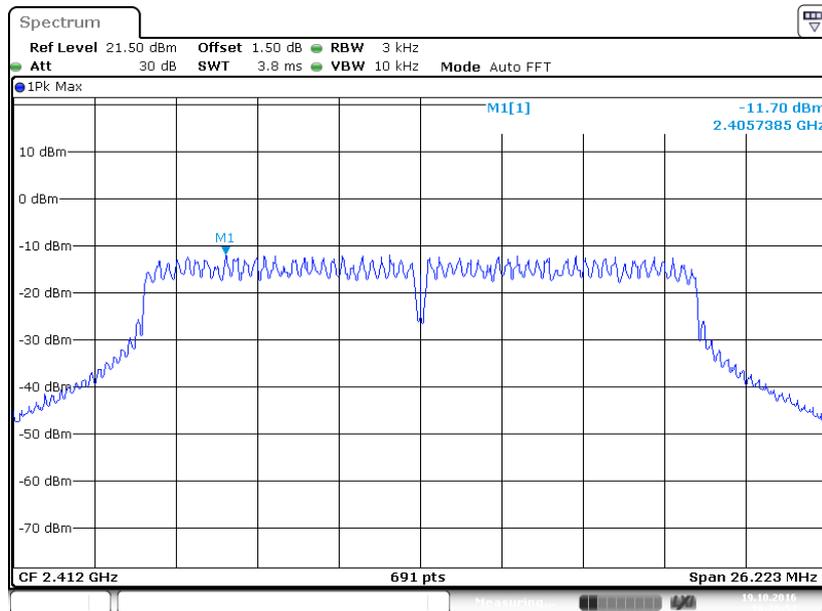
### Chain 0 Power Spectral Density, 802.11g Middle Channel



### Chain 0 Power Spectral Density, 802.11g High Channel

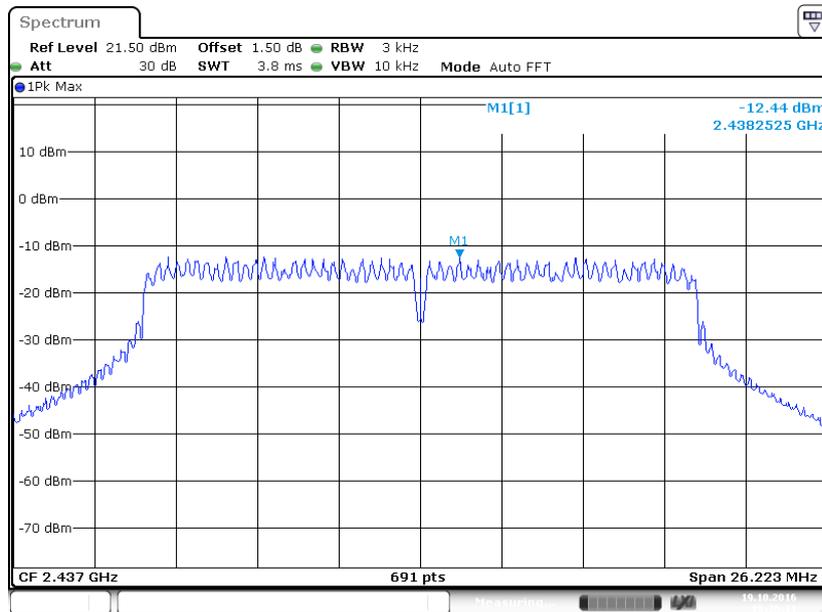


### Chain 0 Power Spectral Density, 802.11n-HT20 Low Channel



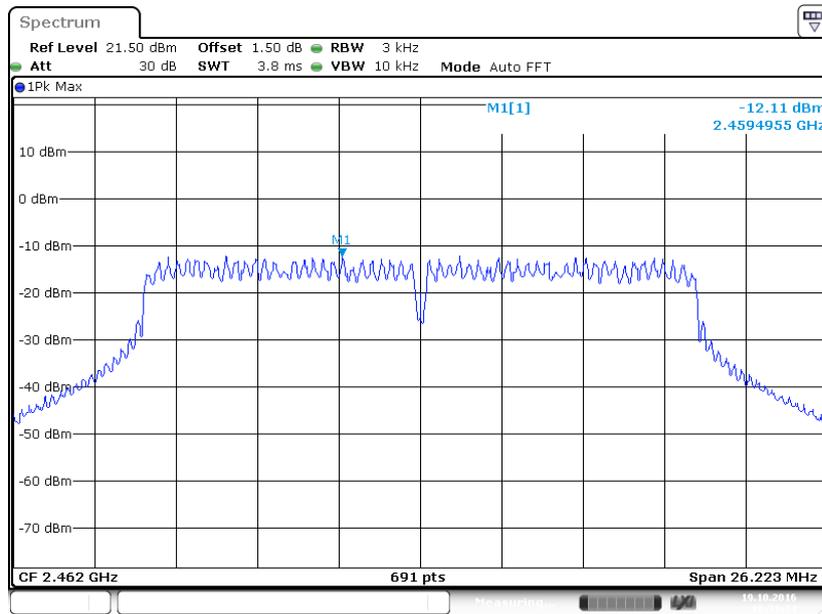
Date: 19.OCT.2016 18:28:53

### Chain 0 Power Spectral Density, 802.11n-HT20 Middle Channel

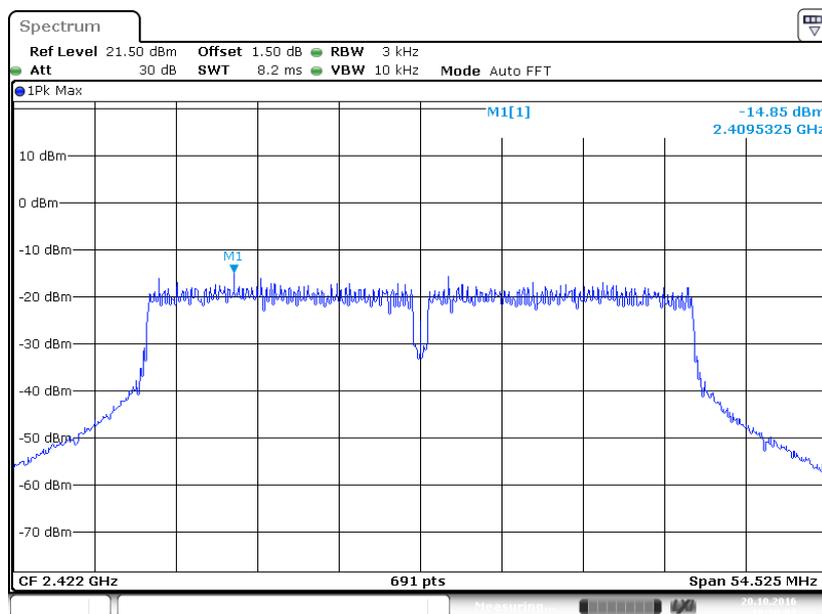


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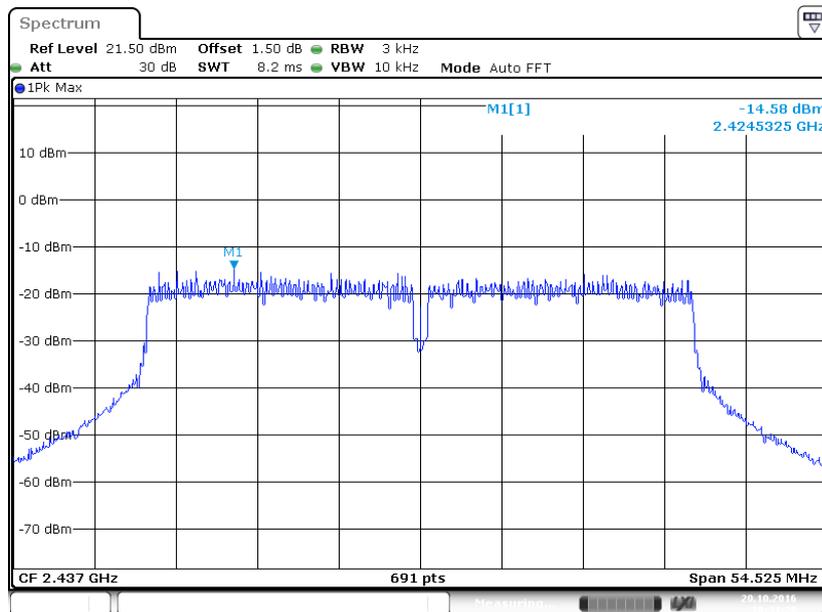
### Chain 0 Power Spectral Density, 802.11n-HT20 High Channel



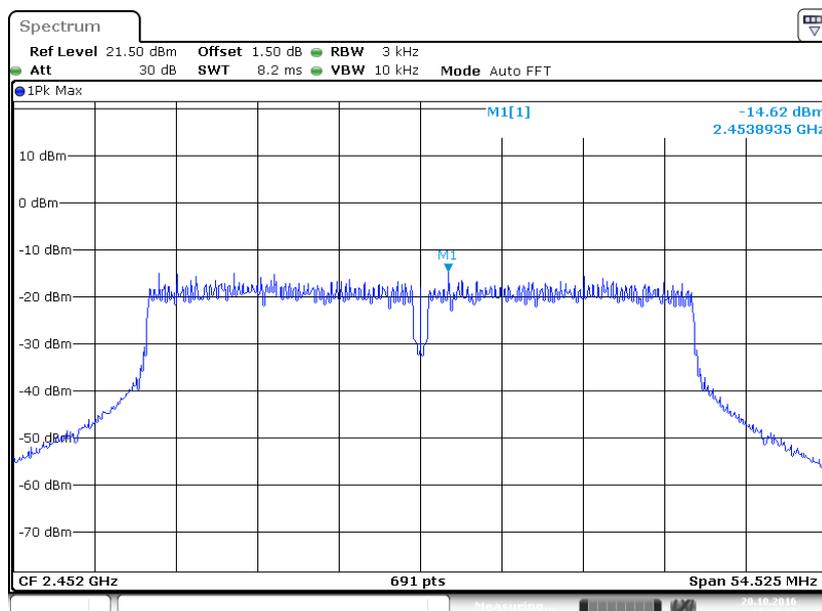
### Chain 0 Power Spectral Density, 802.11n-HT40 Low Channel



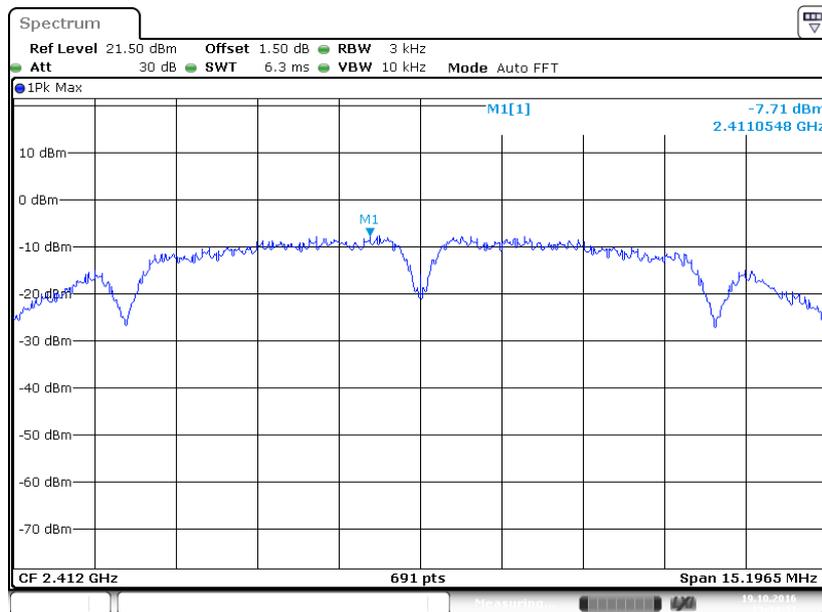
### Chain 0 Power Spectral Density, 802.11n-HT40 Middle Channel



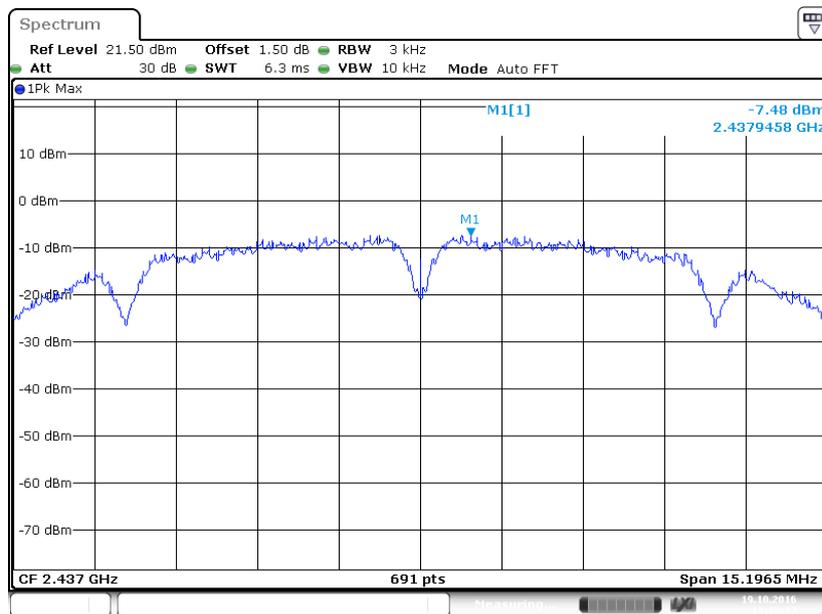
### Chain 0 Power Spectral Density, 802.11n-HT40 High Channel



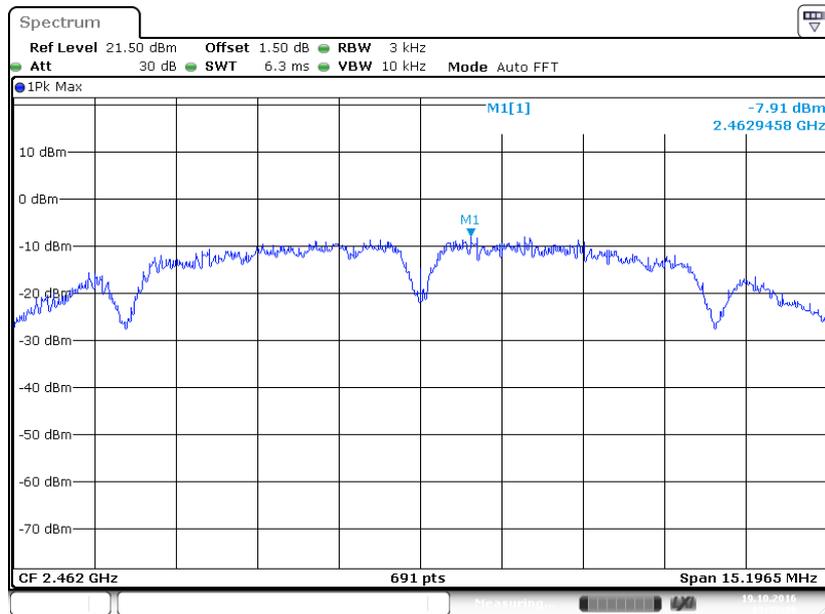
### Chain 1 Power Spectral Density, 802.11b Low Channel



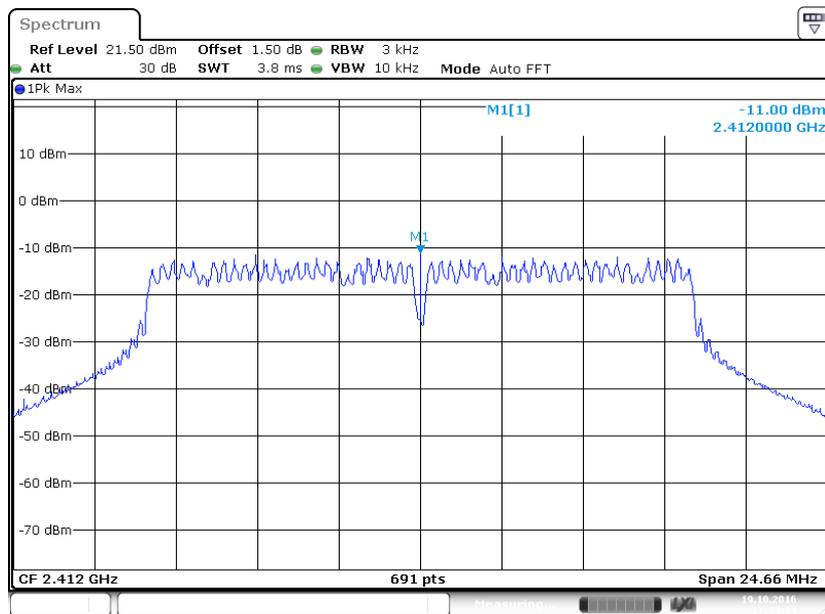
### Chain 1 Power Spectral Density, 802.11b Middle Channel



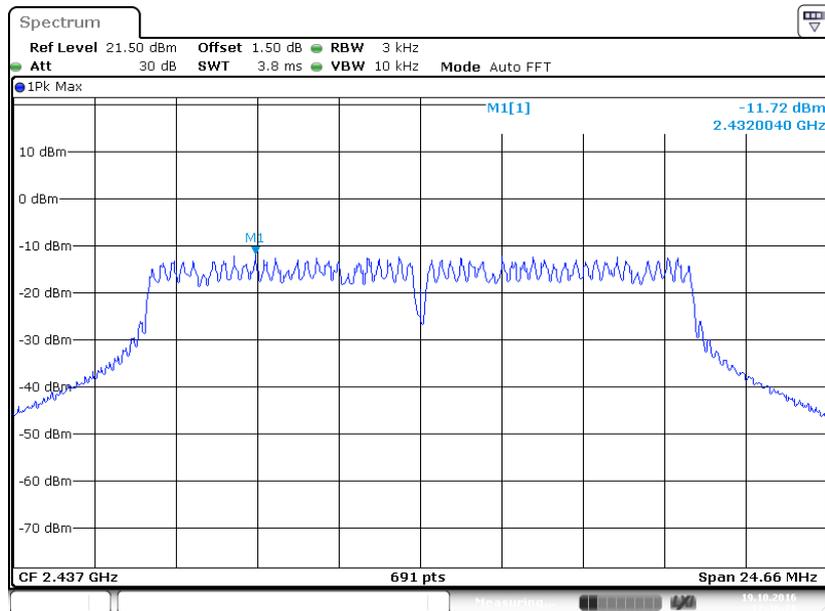
### Chain 1 Power Spectral Density, 802.11b High Channel



### Chain 1 Power Spectral Density, 802.11g Low Channel

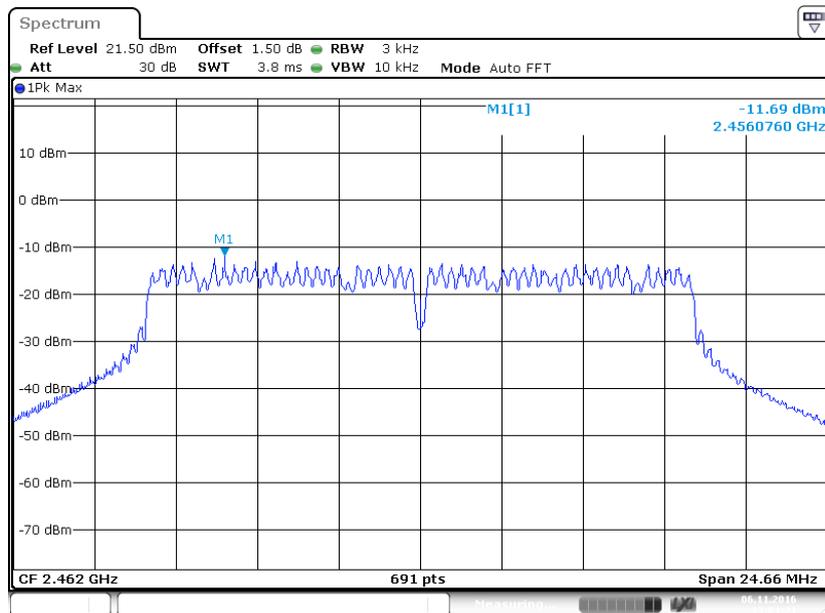


### Chain 1 Power Spectral Density, 802.11g Middle Channel



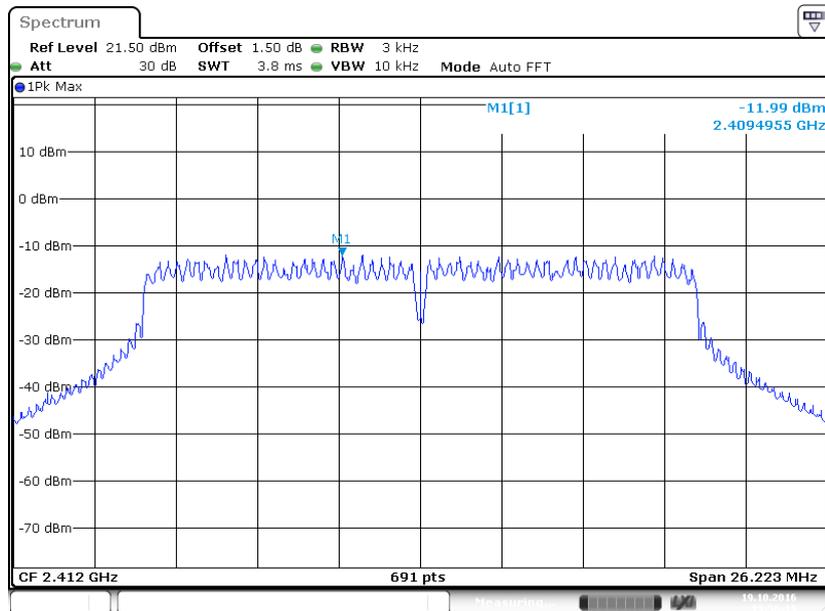
Date: 19 OCT. 2016 17:36:28

### Chain 1 Power Spectral Density, 802.11g High Channel



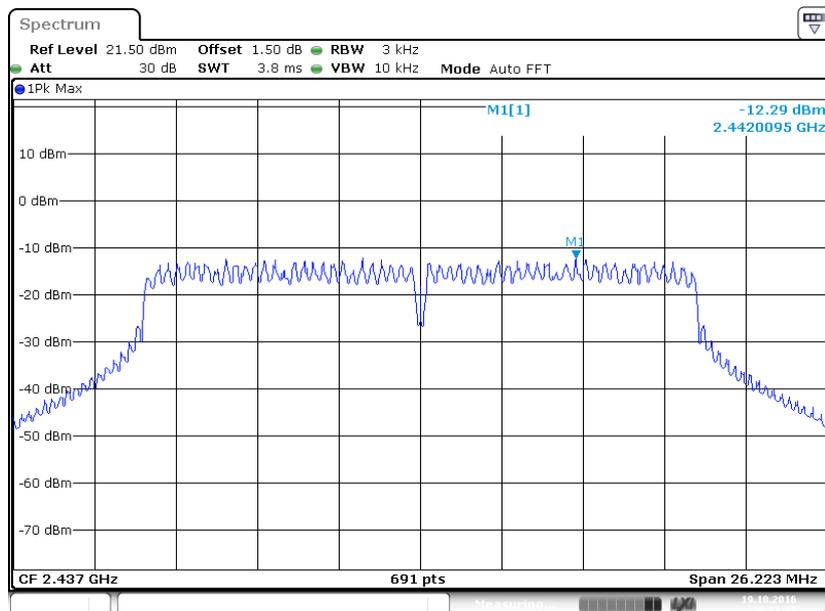
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### Chain 1 Power Spectral Density, 802.11n-HT20 Low Channel



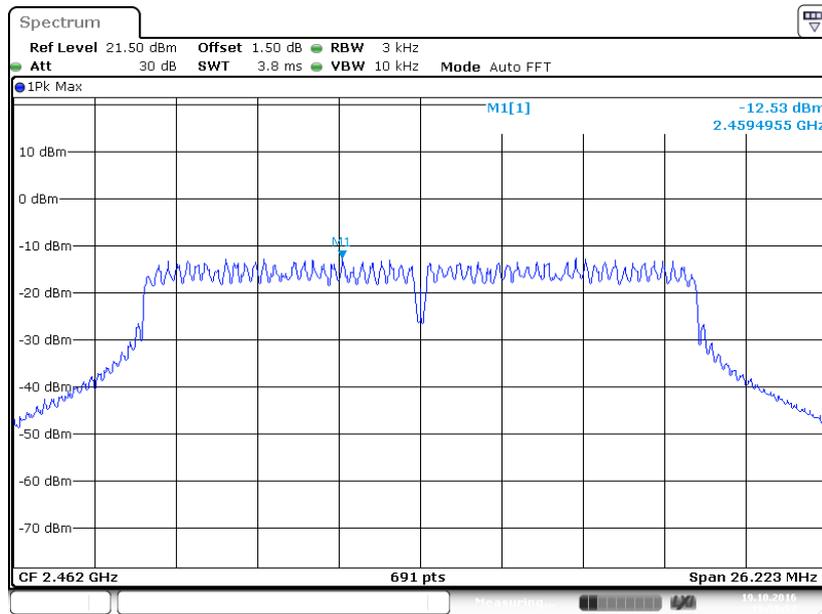
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### Chain 1 Power Spectral Density, 802.11n-HT20 Middle Channel

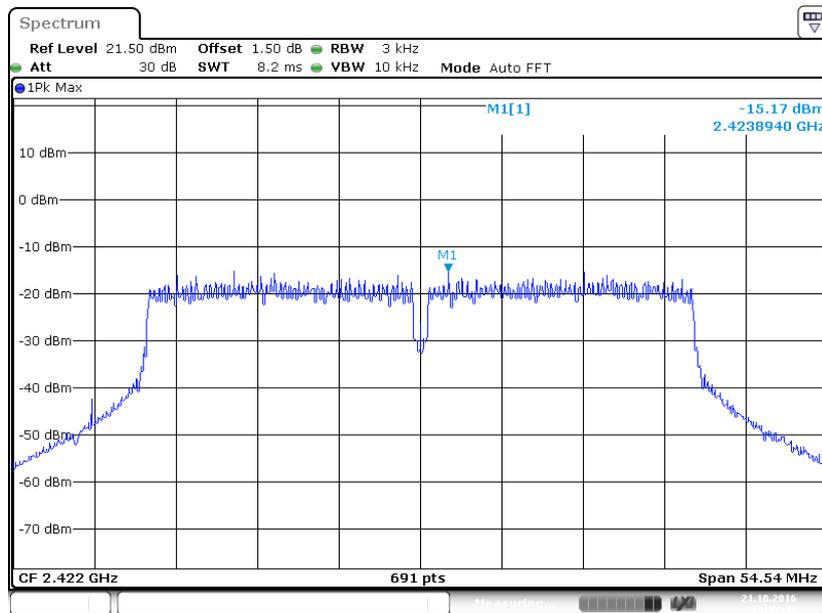


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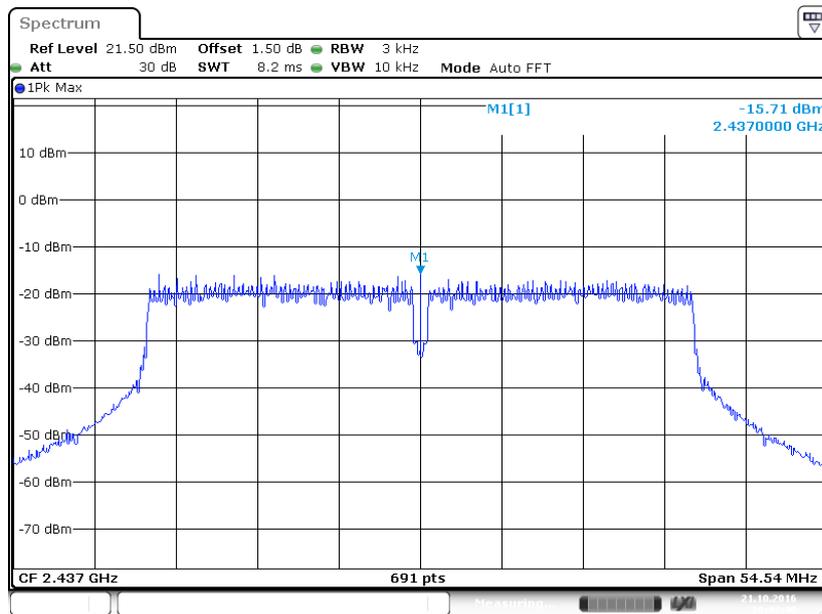
### Chain 1 Power Spectral Density, 802.11n-HT20 High Channel



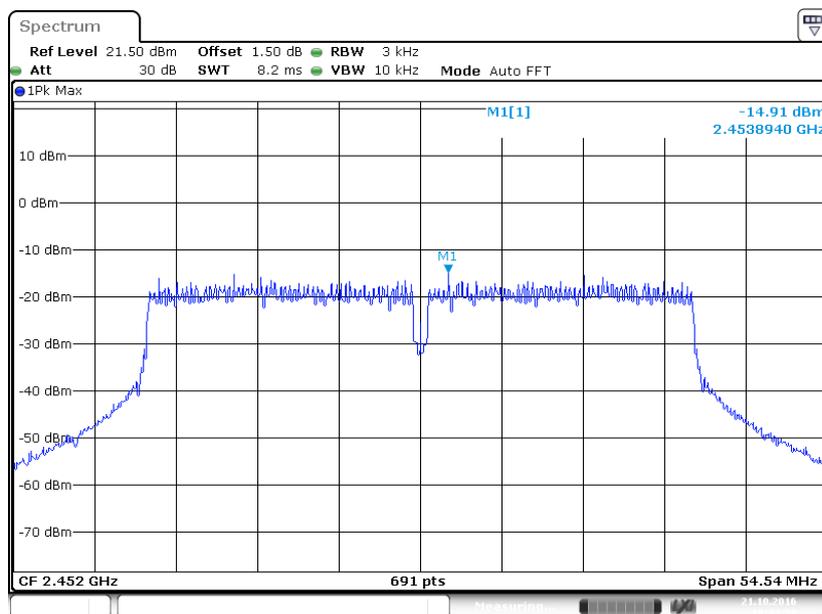
### Chain 1 Power Spectral Density, 802.11n-HT40 Low Channel



### Chain 1 Power Spectral Density, 802.11n-HT40 Middle Channel



### Chain 1 Power Spectral Density, 802.11n-HT40 High Channel



\*\*\*\*\* END OF REPORT \*\*\*\*\*